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MICHAEL RODAK, JR.,

IN THE

Supreme Court of the United States

October Term, 1973

No. 73-1590

DYNEX INDUSTRIAL PLASTICS CORP.,

Petitioner,

v.

ANCHOR PLASTICS COMPANY, INC.,

Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE THIRD CIRCUIT

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IN THE

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October Term, 1973

DYNEX INDUSTRIAL PLASTICS CORP.,
Petitioner,

v.

ANCHOR PLASTICS COMPANY, INC.,
Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE THIRD CIRCUIT

Petitioner, the defendant below, prays that the Court issue a writ of certiorari to review the judgment order of the United States Court of Appeals for the Third Circuit entered February 22, 1974.

Opinions Below

The opinion of the United States District Court for the District of New Jersey (Appendix A to this petition) is reported at 363 F. Supp. 582, 179 U.S.P.Q. 265 (1973). The United States Court of Appeals for the Third Circuit, by judgment order dated February 22, 1974 (Appendix C to this petition), affirmed the judgment of the District Court without opinion. Petitioner's petition for rehearing was denied by the Court of Appeals without opinion.

Jurisdiction

The judgment order of the Court of Appeals was dated and entered on February 22, 1974. The Court of Appeals denied petitioner's petition for rehearing on March 25, 1974. Petitioner invokes the jurisdiction of the Court under 28 U.S.C. § 1254(1).

Questions Presented

I. Contrary to this Court's decision in *Sinclair & Carrol Co., Inc.* v. *Interchemical Corp.*, 325 U.S. 327 (1945), does the selection of a known commercially available material for substitution in an old process in order to achieve the result for which the material selected is known to be especially suited constitute invention under the Patent Laws (35 U.S.C. § 103)?

II. Where, in order to secure allowance of a patent claim to an otherwise old extrusion-lamination process, the applicant characterized as the sole *essential feature* of the process the provision of a lacquer-coated foil and where it is shown that the same lacquer-coated foil had been used in the prior art in a highly analagous sheet-lamination process for heat-seal laminating the same materials at extrusion temperatures, can the claim be held valid?

III. Can an unambiguous patent claim be saved from invalidity because of complete anticipation by a single prior art reference by engrafting additional limitations on the claim language to provide novelty where:

a) the claim language is clear and free from ambiguity,

b) there was no evidence presented that the claim is ambiguous, and

c) the major limitation added to the claim to avoid anticipation and provide novelty is not only

not found in the claim language, it is not even mentioned in the specification of the patent in suit, viz., "hot melt" extrusion?

IV. Can an unambiguous patent claim be saved from invalidity because of inoperativeness by engrafting additional limitations on the claim language, where:

a) the claim language is clear and free from ambiguity,

b) there was no evidence presented that the claim is ambiguous, and

c) the additional limitations are not disclosed in the patent?

Statutes Involved

The questions presented by this petition require interpretation of the Patent Laws, Title 35 U.S.C. §§ 101, 102, 103 and 112, all of which are set forth at length in Appendix E to this petition.

Statement of the Case

The Proceedings Below:

This is a civil action for patent infringement originally brought, in the United States District Court for the District of New Jersey by the respondent, Anchor Plastics Company, Inc. ("Anchor" hereinafter), against the petitioner, Dynex Industrial Plastics Corp. ("Dynex" hereinafter), pursuant to the patent laws of the United States, Title 35 U.S.C., for infringement of United States Letters Patent No. 3,136,676 ("the Fisch patent" hereinafter). Jurisdiction was conferred upon the District Court by Title 28 U.S.C. § 1338(a). After trial, the District Court entered an opinion (Appendix A to this petition) holding the Fisch patent to be valid and infringed by Dynex.

On appeal to the United States Court of Appeals for the Third Circuit, the decision of the District Court was affirmed without opinion by judgment order (Appendix C to this petition) entered February 22, 1974. Upon petition for rehearing to the Court of Appeals, the petition was denied, again without opinion, by order entered March 25, 1974 (Appendix D to this petition). Accordingly, the opinion of the District Court is the only opinion in this case and must be deemed to have been adopted by the Court of Appeals as its own.

The mandate of the Court of Appeals has been stayed pending the filing of this petition.

The Alleged Invention:

The alleged invention claimed in the Fisch patent relates generally to an extrusion-lamination process designed to coat a metal (generally aluminum) foil with a transparent thermoplastic material to produce a variety of shapes of decorative trim strips for application to automobiles, television sets, hair dryers, furniture and other items. The products of the process have a shiny metallic appearance.

Prior to the alleged invention, Anchor and its then sole competitor, "Glass" [1], produced for commercial sale substantial quantities of such trim by extrusion-laminating a transparent thermoplastic material about an uncoated aluminum foil. This prior art process was accomplished by pulling a narrow strip of aluminum foil through the head and die opening of a conventional cross-head extruder while the extruder melted solid transparent thermoplastic material and, at the die opening, coated the moving foil with a layer of the plastic. This is the same way that varicolored plastic-coated telephone wire is produced. The prior art process worked. It produced an attractive

[1] "Glass" refers to Glass Laboratories, Inc., a company owned and run by Jesse and Victor Shanok.

product and hundreds of thousands of dollars worth of the product was sold.

However, the product of the prior art process left something to be desired. The transparent thermoplastic material did not truly laminate to the foil. Adhesion was either non-existent or nonuniform. The products of the prior art process were prone to separations of the plastic from the foil and to "wrinkling" [2] or deformation of the foil. Both separations and wrinkling resulted in visible appearance defects in the extrusion lamination product.

To solve its customer complaint problems related to separation of the extruded plastic from the foil and to wrinkling of the foil during and/or after its extrusion-lamination process Anchor simply selected and substituted in the old extrusion-lamination process a commercially available adhesive lacquer-coated aluminum foil for the previously utilized unlacquered foil. The foil selected, a cellulose nitrate lacquer-coated foil manufactured by Whitaker Paper Company, was one widely known to produce good adhesion of aluminum foil to compatible thermoplastic sheets and films in highly analogous heat-seal sheet-lamination processes conducted at extrusion temperatures.

The result was as expected. The heat-seal lacquer coating adhesively fixed the foil to the extruded thermoplastic material. Separations no longer occurred. The foil and the extruded thermoplastic having become a unitary structure, the foil was not nearly as prone to wrinkle

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[2] In the proceedings below, Dynex asserted that there was no evidence of a "wrinkle" unassociated with a separation and that most, if not all "wrinkles" as well as separations occurred after extrusion and in the hands of customers. For purposes of this petition, however, Dynex does not assert this fact issue, and this Court may assume, arguendo, that "wrinkles" occurred both during and after extrusion and may or may not have always been the result of separations. The fact remains, as found both by the Patent Office Board of Appeals and the District Court and as stated in the Fisch patent, that there were problems of nonadhesion, nonuniform adhesion and separation of plastic from foil in the products of the prior art process.

within the encapsulating thermoplastic layers to which it was adhesively fixed. A true extrusion heat-seal lamination was achieved.

Having discovered through trade channels that Anchor had produced a superior adhesively laminated product, Anchor's then sole competitor, Glass, *promptly and independently* selected a commercially available heat-seal lacquer-coated foil supplied by a different manufacturer, Singen. The same expected result was achieved, a true heat-seal extrusion-lamination of the foil to the extruded thermoplastic material.

The Fisch Patent Claims:

Dynex is held to have infringed claims 1, 2 and 3 of the Fisch patent.[3] In each of the aforementioned claims, two steps are specified in combination:

Step 1 (a selection step): *providing a metal foil having a coating of* a transparent thermoplastic

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[3] Claims 1, 2 and 3 of the Fisch Patent are:

I claim:

1. In the process of preparing extruded thermoplastic products with at least one visible region thereof having a metallic appearance, the steps comprising

providing a metal foil having a thin, film-like coating of a transparent thermoplastic lacquer of the group consisting of cellulose nitrate, cellulose butyrate, ethyl cellulose, and polyvinyl acetate-polyvinyl chloride lacquers on at least one surface thereof,

extruding a transparent thermoplastic material about the lacquer-coated foil while feeding the foil in unison with the thermoplastic material with the surface of the foil containing the lacquer coating contacting the interior surface of the extruded material whereby the lacquer-coating of the foil adhesively fixes the position of the latter with respect to the extruded material.

2. The process as set forth in claim 1 in which the metal foil is an embossed foil containing a multiplicity of facets adapted to reflect light in various directions.

3. The process as set forth in claim 1 in which the metal foil comprises a layer of said thermoplastic lacquer on the surfaces of both sides thereof and in which the thermoplastic material is extruded to contact both lacquer-coated sides of said film.

lacquer of one of four specified types, to wit: *cellulose nitrate, cellulose butyrate, ethyl cellulose* and *polyvinyl acetate-polyvinyl chloride;* and

Step 2 (an extrusion-lamination step): extruding a transparent thermoplastic material about the foil while feeding the foil in contact with the extrudate.

The "whereby" language merely explains the expected result of the process, the problem sought to be solved, to wit: to adhesively fix the foil to the extrudate.

None of the claims is limited to "*hot-melt*" extrusion-lamination. None of the claims is limited to an extrusion-lamination process in which the lacquer-coated foil is passed through the cross-head and die opening of the extruder. Moreover, according to the express wording of the claims, any of the four specified lacquer-coated foils may be adhesively fixed to any extruded thermoplastic material. There was no finding by the District Court that the language of the Fisch patent claims is ambiguous and, indeed, there was no testimony to this effect at trial.

At trial, it was shown by clear and uncontroverted evidence that the unambiguous language of the claims of the Fisch patent overclaim and include a process which will not work to adhesively fix the foil to the extruded material. That inoperative process (a) selects the only transparent thermoplastic lacquer-coated foil which, used by Dynex, was held to have infringed the Fisch patent and (b) extrudes about the lacquer-coated foil the only transparent thermoplastic material identified anywhere in the Fisch patent. The inoperative process would combine a foil coated with polyvinyl acetate-polyvinyl chloride lacquer (the accused foil used by Dynex) with cellulose acetate the only specific extruded thermoplastic material mentioned in the Fisch patent).

The Prior Art:

The prior art relied upon by Dynex with respect to obviousness pursuant to 35 U.S.C. § 103 includes U.S. Patent No. 2,774,811 to Shanok et al. This Shanok '811 patent, which was considered by the Patent Office at the time of allowance of the Fisch patent, completely discloses (Appendix G to this petition, col. 2, lines 16-25) step 2 of the process claimed by Fisch, the extrusion-lamination step, except that an unlacquered foil is employed.

> "In practice it has been found advantageous to utilize a transparent plastic material which is extruded over a ribbon of aluminum foil.... A suitable plastic material for this purpose is cellulose acetate butyrate...."

To complete the prior art anticipation of the Fisch claims for obviousness under 35 U.S.C. § 103, Dynex relies on any one of three prior art publications in combination with the Shanok '811 patent. These publications (Appendices H, I and J), which were not considered by the Patent Office prior to allowance of the Fisch patent, each disclose the selection step 1 of the Fisch claims by teaching the heat-seal lamination of transparent thermoplastic sheeting to aluminum foils coated with one or more of the specific adhesive lacquers named in the Fisch claims.

The prior art Alcoa publication (Appendix H) entitled "*Alcoa Aluminum Foil, Its Properties and Uses*", at page 12 (App. 76a), describes the laminating process of bonding aluminum foil to sheets of transparent thermoplastic material by *heat-sealable adhesive coatings* applied to one or both surfaces of the foil and by bringing the foil into contact with the sheet between *heated* pressure rolls as illustrated in Figure 8, on page 13 (App. 77a), of this publication. The heat-sealing adhesive coatings described on page 17 (App. 81a) of the Alcoa publication include three

of the four adhesives claimed in the Fisch patent as follows:

> "Heat-seal coatings of the *vinyl type* are considered to be the most satisfactory all around materials for use on aluminum foil. Heat-seal coating based on *cellulose nitrate, ethyl celluloses* . . . have also been used satisfactorily on aluminum foil." (Emphasis supplied).

The prior art publication entitled *"Coatings and Coating Methods for Aluminum Foil"* (Appendix I) describes thermoplastic adhesive coatings on aluminum foil for laminating by the application of *heat* and names three of the four thermoplastic adhesive coatings claimed in the Fisch patent. Mr. Robertson, the author, describes these adhesives as follows (App. 93a):

> ". . . The following film formers are used for this type of coating in varying degrees: *nitrocellulose, ethyl cellulose,* vinyl chloride-vinyl acetate-maleic anthydride tripolymer . . . *vinyl chloride-vinyl acetate copolymers,* . . ." (Emphasis supplied).

The prior art publication, *Modern Packaging* (Appendix J), published in 1948, under the heading "Aluminum Foil Laminates", teaches that to bond aluminum foil to other materials, including thermoplastic film, specific adhesives must be selected for the specific foil combination as follows (App. 99a):

> "In laminating plastic films with aluminum foil, . . . This means that the adhesive should be selected for the specific plastic-foil combination to be laminated. For example, *nitrocellulose-type* adhesives find particular application in laminating cellophane and other cellulose films, whereas *vinyl-resin adhesives* have been found quite satisfactory for acetate and certain other types of plastic films. . . ." (Emphasis supplied).

Moreover, Dynex asserts that claim 1 of the Fisch patent is invalid pursuant to 35 U.S.C. § 102 for want of novelty. Each and every element of claim 1, the main and only independent claim of the patent in suit, is disclosed by the prior art United States patent to Nadeau (No. 2,685,511 —Appendix L). This exact correspondence was uncontested and is shown in detail hereinafter. To save the claim from anticipation by the Nadeau prior art patent, to supply novelty the words "hot melt" and "through the extrusion die" were engrafted by the District Court into the clear and unambiguous claim language.

The Nadeau patent discloses the *extrusion* of a transparent thermoplastic material on a metal foil coated with a vinyl chloride-vinyl acetate adhesive, and claim 1 of the patent in suit claims the exact same process. Thus, there is *no* novelty whatsoever in the subject matter as stated in the unambiguous language of claim 1 of the patent in suit.

REASONS FOR GRANTING THE WRIT

I. The Court Should Review the Decision Below Because That Decision is in Conflict with the Prior Decisions of this Court on a Federal Question —Patentability under 35 U.S.C. § 103

As noted in the Statement of the Case, the claims of the Fisch patent which Dynex has been held to have infringed are combination process claims to:

a selection step: *providing a metal foil having a coating of* a transparent thermoplastic lacquer of one of four specified types, to wit: *cellulose nitrate, cellulose butyrate, ethyl cellulose and polyvinyl acetate-polyvinyl chloride;* and

an extrusion-lamination step: extruding a transparent thermoplastic material about the foil while feeding the foil in contact with the extruded thermoplastic material.

The extrusion-lamination step, utilizing an uncoated aluminum foil, was clearly practiced identically in the prior art and is fully disclosed in the Shanok '811 patent (Appendix G, col. 2, lines 16-25). The problem confronting the patentee was how to avoid unsightly separations of the foil from the plastic and wrinkling of the foil. The solution was to adhesively fix the extruded thermoplastic material to the foil. To achieve the solution it was necessary for the patentee to *select* an aluminum foil coated with a suitable heat-sealable adhesive lacquer. Such lacquer-coated foils were widely known and commercially available (Appendix H, p. 81a, Appendix I, p. 93a).

With the problem reduced to the *selection* of suitable, commercially available adhesive lacquer-coated foil to meet the known process and product requirements of providing complete and even adhesion of the foil to the extruded thermoplastic material—a true lamination, this Court's decision in *Sinclair & Carroll Co., Inc.* v. *Interchemical Corp.*, 325 U.S. 327 (1945), clearly indicates the obviousness of Fisch's selection. In that unanimous decision, this Court held that the patentee's selection of a chemical from a catalog as the solvent for a heat-drying ink was not patentable. The Court, at 335, stated:

> "Even assuming that if Gessler had discovered the compound he would be entitled to a patent, he did not discover it. Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put into the last opening in a jig-saw puzzle. It is not invention."

At the trial, Anchor's own expert has testified that the selection of an adhesive was the obvious solution to the delamination problem of Anchor's prior art process.

> "Q. Back in time, 1953, 1954, Dr. Bruins, when there were problems of *delamination* between foils

> and transparent plastic materials the *obvious solution* to these problems were the *addition of adhesives,* were they not? A. Yes, sir". (Emphasis supplied).

Professor Bruins further testified that the very adhesives claimed by Fisch would be the obvious ones to try.

> "Q. Well, let's say at least one skilled in the art would at least try these adhesives, would they not, a vinyl type, a cellulose nitrate or ethyl cellulose adhesive, would they not? A. They would try, and that is evidenced, of course, by the Fisch patent.
>
> Q. And these would be obvious adhesives that one would selection and try, would they not? A. Yes".

In holding that Fisch's selection of a foil coated with a known heat-sealable adhesive lacquer for use in the old extrusion-lamination process of the Shanok '811 patent was unobvious, hence inventive and patentable under the provisions of 35 U.S.C. § 103, the District Court apparently relied heavily on the fact that the selection of the lacquer-coated foil not only expectedly eliminated the problem of separation of the foil from the extruded thermoplastic by adhesively laminating them together, but that it also resulted in the incidental benefit of eliminating wrinkling of the foil. It is submitted that the incidental solution of a wrinkling problem in the course of an obvious attack on a problem of separation due to nonadhesion does not amount to invention.

In accordance with this Court's decision in *General Electric Co.* v. *Jewel Incandescent Lamp Co.,* 326 U.S. 242 (1945), one does not become entitled to a patent by discovering a new *benefit* of a process, but only by discovering an unobvious *process.* The process of the Fisch patent was obvious as a solution to the problem of separation or

delamination due to nonadhesion, and the fact that it might have had the incidental benefit of preventing wrinkling is simply irrelevant.

The law is clear that patents are granted for unobvious processes (methods) and not for the discovery of additional benefits which flow from obvious methods. The Patent Act, 35 U.S.C. § 101 states that a patent may be for ". . . any new and useful process . . .", that is, the Patent Act requires that the process itself be unobvious under 35 U.S.C. § 103.

As stated in *Preuss* v. *General Electric Co., Inc.*, 392 F. 2d 29 (2nd Cir. 1968), *cert. denied*, 393 U.S. 834 (1968), (at F.2d 33-34)

> "A balanced signal/noise ratio also inhered in his solution. If there was, as there was here, an obvious reason for solving the principal feature of a problem, e.g., monophonic compatability on FM stereo, the doing of it does not become nonobvious because incidental values inhered in this solution. *General Electric Co.* v. *Jewel Incandescent Lamp Co.*, 326 U.S. 242, 66 S. Ct. 81, 90L. Ed. 43 (1945)."

The District Court apparently considered each of the heat-seal lamination prior art publications put in evidence by Dynex separately and never considered the *combined* teachings of the prior art Shanok '811 patent and the heat-seal lamination prior art.

The Dynex obviousness argument is based upon combinations of the teachings of the cited prior art Shanok '811 patent (Appendix G) with the prior art of heat-seal lamination utilizing the metal foils coated with the specific claimed adhesive lacquers (Appendices H, I and J). This heat seal lamination prior art disclosing *metal foil coated with the claimed adhesive lacquers* for bonding to thermoplastic materials was *not* before the Patent Office. This is

the *critical* issue in this case. The Patent Office issued the patent in suit because of Fisch's arguments to the Board of Appeals that the *"essential feature"* of the claimed process was the *"lacquer-coated foil"*, Dynex's uncited prior art references fully disclose this *essential feature*, such lacquer-coated foils. Fisch's argument representing the importance of this issue to the Board of Appeals in the "Brief for the Applicant" is as follows:

> "None of the references disclose the *essential feature* of applicant's process or product, the *lacquer-coated foil.*" (Emphasis supplied).

The Patent Office, although it did not become aware of any of the specific heat-seal sheet-lamination art relied upon by Dynex in this case, certainly considered sheet-lamination art as within the scope of the art pertinent to the Fisch patent application. This is evidenced by the Examiner having cited sheet-lamination patents as well as extrusion-lamination patents in the file history of the Fisch patent.

II. The Court Should Review the Decision Below Because That Decision is in Conflict with the Prior Decisions of this Court on a Second Federal Question—Patentability Under 35 U.S.C. § 102

The Courts Have Undermined Patent Certainty By Reading Words Into Unambiguous Claims To Avoid The Prior Art:

A patentee may present any patent claim he chooses to the Patent Office. If he goes beyond the true scope of his invention by *overclaiming* and broadly claims subject matter within the public domain, the claim is invalid under 35 U.S.C. § 102. Only if the claim is ambiguous on its face should there be resort to the specification to save it. Such is the teaching of the decisions of this Court in *Graver Tank and Manufacturing Co., Inc.*, v. *Linde Air Products*

Co., 336 U.S. 271, 277 (1949) which set out the rule to be followed to determine if there was *overclaiming*. In *Graver Tank* the Court set out this rule at page 277:

> "While the cases more often have dealt with efforts to resort to specifications to expand claims, it is clear that the latter fail equally to perform their function as a measure of the grant when they overclaim the invention. *When they do so to the point of invalidity and are free from ambiguity* which might justify resort to the specifications, we agree with the District Court that *they are not to be saved because the latter are less inclusive.*" (Emphasis supplied).

The District Court ignored the above rule set out in *Graver Tank*, and decided to the contrary (Appendix, p. 14a):

> "Nor can I engage in a restricted reading of the claims in suit, as defendant would have me do, so as to ignore that they deal with hot melt extrusion. That this knowledge is drawn from the patent specification and not the bare language of the claims does not vitiate it. As the United States Supreme Court stated in *United States* v. *Adams*, 383 U.S. 39, 49 (1966):
>
> > . . . it is fundamental that claims are to be construed in the light of the specifications and both are to be read with a view to ascertaining the invention. . . ."

Thus, the District Court justified the rewording of claim 1 by the addition of restrictive requirements from the specification to save the claim from its lack of novelty by quoting out of context from *United States* v. *Adams*, 383 U.S. 39, 49 (1966) that "claims are to be construed in the light of the specifications". This quotation from the *Adams* case

did not relate to an analysis of the application of the rules for determination of whether the patent in suit is anticipated under 35 U.S.C. § 102. This is clear from the fact that the cases cited in *Adams* as authority for this statement relate to a determination of the scope of a claim and not to the issue of anticipation under 35 U.S.C. § 102. In addition, the Supreme Court in *Adams, supra,* at page 48, recognizes that "lack of novelty under 35 U.S.C. § 102(a) and obviousness under 35 U.S.C. § 103" are separate tests of patentability. The *Adams* case did not overrule *Graver Tank,* and is not opposed to it.

The process that occurred in this case, in which the District Court rather than the patentee writes the patent claim, is unfair to the public and makes the patent monopoly uncertain. This approach is particularly egregious in this case as not only do the claims fail to mention "hot melt", but this term is not even found in the specification of the patent in suit. Any prior art can be avoided by a skillful rewording of the patent claim by random selection of portions of the specification. An unambiguous claim, as printed in a patent, cannot be relied upon as a court may add new words from the specification. A patent claim's validity cannot be opined upon because the claim may later be changed by a court.

Detail of the Full Anticipation of the Claimed Subject Matter of the Patent in Suit by the Nadeau Prior Art Patent:

The lack of novelty between the process of claim 1 of the patent in suit and the anticipating Nadeau process is shown in the following chart:

Claim 1 of Patent in Suit	Anticipating Nadeau Patent No. 2,685,511 (Appendix L)
Step 1: "In the process of preparing extruded thermoplastic products with at least one visible region thereof having a metallic appearance, *the steps* comprising providing a metal foil having a thin film-like coating of a transparent thermoplastic lacquer of the group consisting of cellulose nitrate, cellulose butyrate, ethyl cellulose and *polyvinyl acetate-polyvinyl chloride* lacquers on at least one surface thereof.	"aluminum foil" (column 7, lines 1-3) is coated with an "interpolymeric resin" containing vinyl chloride-vinyl acetate (column 7, lines 1-7).
Step 2: *extruding a transparent thermoplastic material* about the lacquer-coated foil while feeding the foil in unison with the thermoplastic material with the surface of the foil containing the lacquer coating contacting the interior surface of the extruded material whereby the lacquer-coating of the foil adhesively fixes the position of the latter with respect to the extruded material." (Emphasis supplied).	The coating of transparent thermoplastic material may be cellulose triacetate, cellulose acetate-butyrate, cellulose propionate, cellulose butyrate or cellulose acetate-propionate (column 9, lines 51-57). The actual coating of the transparent thermoplastic can be accomplished by *extrusion* (column 10, lines 9-12). The vinyl chloride-vinyl acetate is the "subbing compound" which acts as an *adhesive*" (column 7, lines 41-48). (Emphasis supplied).

The fact that the claimed process of the Fisch patent lacks novelty was confirmed on cross-examination by plaintiff's expert witness, Professor Bruins, who stated that the Nadeau patent (Appendix L) fully anticipated claim 1 of the patent in suit:

> "Q. In those teachings there in column 7, read in light of the rest of the Nadeau disclosure, do we not have the teaching of the following: The slovent *extrusion* of a solution containing a *thermoplastic material,* namely, cellulose acetate butyrate, *onto a foil, where the foil is precoated with an adhesive consisting of* cellulose acetate—I'm sorry—*polyvinyl acetate and polyvinyl chloride type adhesive,* plus maleic acid. Is that correct, sir? A. I believe what you have stated is correct.
>
> Q. Thank you, Professor Bruins. And then just as a final matter to clarify this matter for the Court, the sensitizing step, that step comes later, does it not? A. Yes." (Emphasis supplied).

The final products produced by Nadeau and the Fisch patent differ. But what is significant here is that the processes are the same, and the claim is for a process and not a product. In addition, it is noteworthy that the final product produced by the Fisch patent and the product produced by Nadeau before his sensitizing step are *identical,* viz., an aluminum foil bonded to the transparent thermoplastic material by the claimed adhesive. For anticipation, it is irrelevant that the end uses of these products are different or that the Nadeau product undergoes further steps so that the Nadeau product produced by the extrusion step, viz., an aluminum foil bonded to a transparent thermoplastic material, is, by other subsequent processes, turned into a photographic plate. The end products of the Fisch patent have many uses and there is no limitation to a particular use.

Dynex agrees that the Nadeau patent relates to solvent extrusion as distinguished from hot-melt extrusion, but claim 1 is not limited to "hot-melt" extrusion. Dynex agrees that the Nadeau patent does not specifically state that the foil goes through the die, but neither does claim 1.

From Nadeau the skilled man learned that to adhere the transparent thermoplastic, namely, cellulose triacetate, to foil, one must use a claimed adhesive. The same problem (lack of adhesion between foil and cellulose triacetate) requires the same solution to the problem (use of the adhesive), regardless of whether the solvent extrusion or hot-melt extrusion is used.

The word "extrusion" in claim 1 is used broadly to give the claim a meaning and range beyond the specific details of the disclosure. It is axiomatic in patent law that the words of a claim are not limited to the specific details of the patent specification. Thus the term "extrusion" is not ambiguous[4]; it is merely broad and covers both the hot-melt extrusion of the Fisch patent and Nadeau's solvent extrusion. The Fisch patent itself states "it is accordingly desired that the appended claims not be limited to any specific features or details thereof" (Appendix F, col. 4, lines 73-75, col. 5, lines 1-3). No expert testified that claim 1 was "ambiguous"; but, in determining whether a prior art reference is an anticipation, the meaning of words in a claim is not determined by the opinion of experts. It is a question of law for the court. *Minnesota Mining & Mfg. Co.* v. *Carborundum Co.*, 155 F.2d 746, 749 (3rd Cir. 1946); *Methode Electronics, Inc.* v. *Elco Corporation*, 385 F.2d 138, 140 (3rd Cir. 1967).

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[4] See Webster's International Dictionary, 2nd Edition, page 904

III. The Court Should Review the Decision Below Because that Decision is in Conflict with the Prior Decisions of this Court on Yet a Third Federal Question—Validity of Patent Claims under 35 U.S.C. § 112 and Because there is a Conflict Between the Circuits on this Point

The Courts Have Undermined Patent Certainty By Reading Words Into Unambiguous Claims To Avoid Inoperative Embodiments:

A patentee can limit his claims, when he presents them to the Patent Office, to his actual invention—to those things he knows will work. If he overreaches and he claims more—and includes within his claim that which will not work, he should suffer the consequence of the claim being held invalid. And especially in this case, because not only will something within the claim not work—but the exact materials taught by the specification will not work.

This Court made it clear, in *Graver Tank, supra,* that inoperative embodiments that are within the claim make the claim invalid. The *Graver Tank* case has been followed and was preceded by cases holding that patents are invalid because inoperative products or processes were within the claims, but not named in the specification, such cases including *General Electric Co.* v. *Wabash Appliance Corp.,* 304 U.S. 364, 373-374 (1938); *Aluminum Co. of America* v. *Thompson Products, Inc.,* 122 F.2d 796, 798 (6th Cir. 1941); *Holland Furniture Co.* v. *Perkins Glue Co.,* 277 U.S. 245, 256-257 (1928); *Corona Cord Tire Co.* v. *Dovan Chem. Corp.,* 276 U.S. 358, 385 (1928); *The Incandescent Lamp Patent,* 159 U.S. 465, 472-476 (1895); *Matheson* v. *Campbell,* 78 F. 910 922 (2nd Cir. 1897). Cases decided after the enactment of the 1954 Patent Act include: *Georgia-Pacific Corp.* v. *United States Plywood Corp.,* 258 F.2d 124, 135 (2nd Cir. 1958); *Borg-Warner Corp.* v. *Mall Tool Co.,*

217 F.2d 850, 856 (7th Cir., 1954); *Shelco, Inc.* v. *Dow Chemical Company,* 322 F.S. 485, 509, 510 (D.C. Ill. 1970): and *H. C. Baxter & Bro.* v. *Great Atlantic & Pacific Tea Co.,* 236 F.S. 601, 614 (D.C. Maine 1964). For the importance of requiring that claims be definite see *Halliburton Co.* v. *Walker,* 329 U.S. 1, 10 (1946).

But other Courts, including the Third Circuit in the present case, have heard a different drummer. They rewrite unambiguous patent claims, after grant of the patent, to exclude inoperative embodiments. Such cases are: *Ansul Company* v. *Uniroyal Inc.,* 301 F.S. 273, 288 (S.D. N.Y. 1969), aff'd, 488 F.2d 872, 878 (2nd Cir. 1971); *Noll* v. *O. M. Scott & Sons Co.,* 467 F.2d 295 (6th Cir. 1972) cert. den. 411 U.S. 965 and *Yosemite Chemical Co.* v. *United States,* 360 F.2d 948, 952 (Ct.Claims 1966). For a horrendous example of this practice, one need only look at the present case.

The patent in suit claims "a thermoplastic material" which is extruded over an adhesive-coated foil. The only specific "thermoplastic material" mentioned in the patent is "cellulose acetate", which is mentioned once (Appendix F, col. 3, line 25). The adhesive used with it is "cellulose nitrate" (Appendix F, col. 3, lines 26-27).

The patent claim specifies four adhesives, "cellulose nitrate, cellulose butyrate, ethyl cellulose, and polyvinyl acetate-polyvinyl chloride lacquers". Anchor accuses Dynex based only upon Dynex's use of "polyvinyl acetate-polyvinyl chloride", the other adhesives including cellulose nitrate, being irrelevant to the infringement charge.

But cellulose acetate (the only extruded transparent thermoplastic mentioned in the patent) *will not work* with the "polyvinyl acetate—polyvinyl chloride" adhesive. Uncontested testimony showed that there was no adhesion between the adhesive lacquer-coated foil (coated with polyvinyl acetate—polyvinyl chloride") and extruded cellulose acetate.

Dynex does not use cellulose acetate (the only extruded material specified in the patent); rather, it conventionally extrudes "cellulose acetate butyrate", which sounds like "cellulose acetate" but is a far different material chemically. Anchor's expert admitted the product was unsatisfactory.

The testimony by Dynex's expert was simple, supported by documentary evidence, and uncontroverted. It was (1) that the foil was coated with polyvinyl acetate—polyvinyl chloride lacquer, (2) that cellulose acetate was extruded on the lacquer-coated foil, and (3) that the product was unsatisfactory because the foil and extruded plastic did not adhere. This nonadherence was admitted by Anchor's expert, Professor Bruins.

The District Court made *no finding* as to operativeness of the cellulose acetate—VMCH combination.

Anchor below sought to evade this issue by pretending that the question is, "Does the patent teach *an* operative embodiment?"—an issue not here raised. Dynex freely admits that a skilled man, reading the patent disclosure, could successfully operate and do so without undue experimentation. To succeed he could choose cellulose nitrate lacquer and use it with the cellulose acetate thermoplastic. But such success with cellulose nitrate and lack of required experimentation is irrelevant, because Dynex never used cellulose nitrate lacquer—it uses "VMCH" (based upon polyvinyl acetate—polyvinyl chloride). It is not fair that Dynex should be held liable for using "VMCH"—when it will not work with cellulose acetate—the only extruded thermoplastic taught by the patent.

IV. CONCLUSION

For the foregoing reasons, a writ of certiorari should issue to the Court of Appeals for the Third Circuit.

Respectfully submitted,

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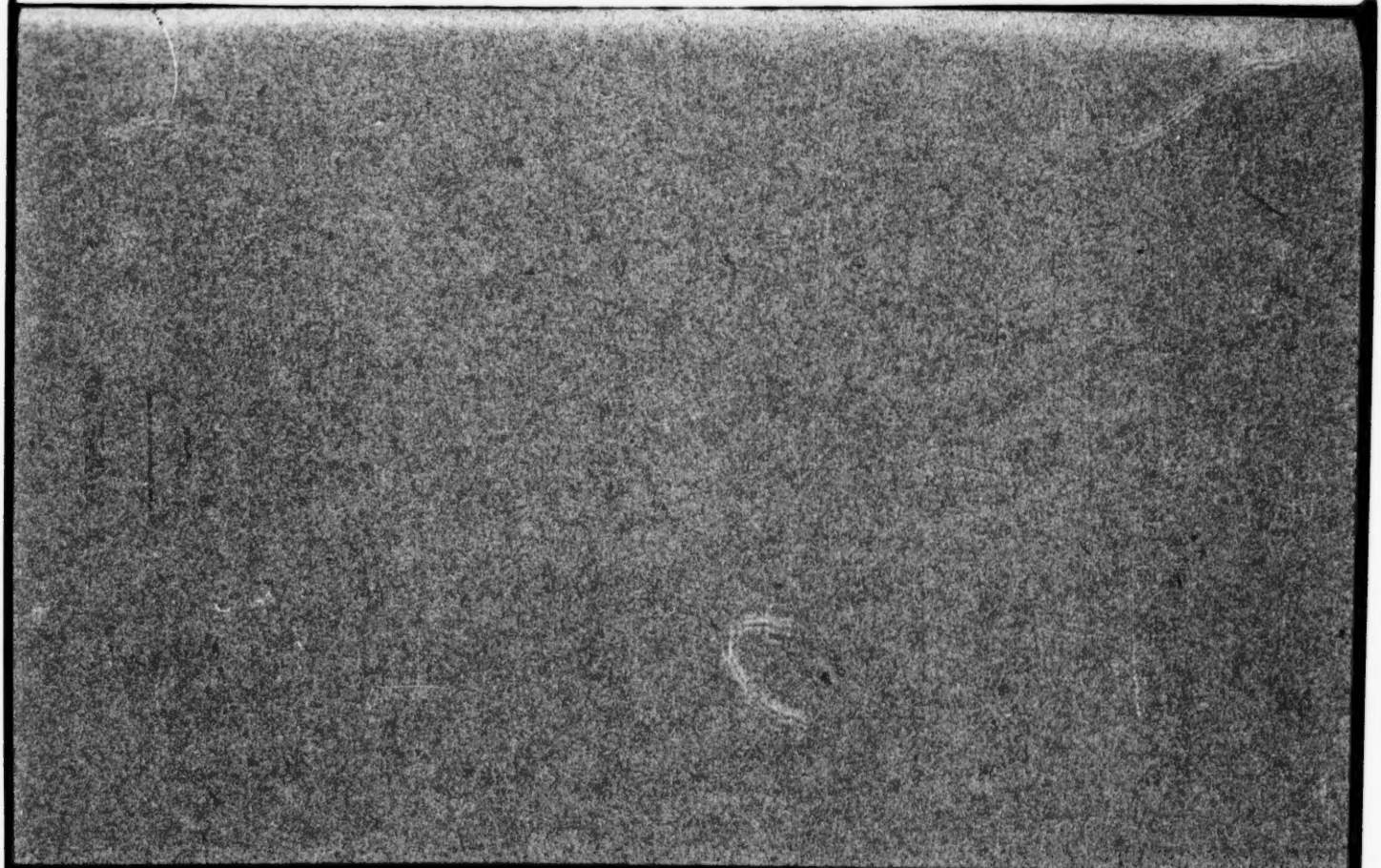
April 23, 1974

APPENDICES



APPENDIX A

Opinion

UNITED STATES DISTRICT COURT

DISTRICT OF NEW JERSEY

Civil Action No. 1495-69

ANCHOR PLASTICS COMPANY, INC.,

Plaintiff,

v.

DYNEX INDUSTRIAL PLASTICS CORP.,

Defendant.

Appearances:

PITNEY, HARDIN & KIPP, Esqs. By: WILLIAM H. HYATT, JR., Esq.

MORGAN, FINNEGAN, DURHAM & PINE, Esqs. By: JEROME G. LEE, Esq. (N.Y.), JAMES P. WELCH, Esq. (N.Y.), Attorneys for plaintiff.

POPPER, BAIN, BOBIS, GILFILLAN & RHODES, Esqs. By: JOHN G. GILFILLAN III, Esq.

WYATT, GERBER & SHOUP, Esqs. By: DOUGLAS W. WYATT, Esq. (N.Y.), ELIOT S. GERBER, Esq. (N.Y.), Attorneys for defendant.

LACEY, *District Judge:*

This is an action for infringement by the assignee of United States Patent No. 3,136,676 (hereinafter called the

Fisch patent), issued on June 9, 1964, for "Metallized Plastic Extrusion Products and Method of Making Same," on an application filed in the United States Patent Office on February 20, 1957.[1]

Plaintiff Anchor Plastics Company, Inc. (Anchor) is a New York corporation, having its principal place of business in Long Island City, New York.

Defendant Dynex Industrial Plastics Corp. (Dynex) is a New Jersey corporation doing business within the District of New Jersey in Rutherford, New Jersey.

This action presents the primary issues of validity and infringement. Plaintiff seeks by way of relief an injunction against continuance of alleged infringement, damages, interest, and costs.

Defendant's answer denies infringement of the Fisch patent, denies its validity, and sets forth numerous affirmative defenses. Defendant asserts no counterclaim.

Subject matter jurisdiction is had over this action by virtue of 28 U.S.C. § 1338(a), and venue is proper under 28 U.S.C. § 1400(b).

Plaintiff is in the business of making and selling plastic extrusion products and, in such business, uses the process described and claimed in the Fisch patent in suit.

This matter was tried before me over 7 trial days, following which the parties submitted post-trial briefs and proposed findings of facts and conclusions of law.

The opinion which follows embodies my own findings of fact and conclusions of law pursuant to Fed.R.Civ.P. 52(a).

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[1] References herein to exhibits and testimony will be as follows:
Plaintiff's Exhibits will be identified as PX——;
Defendant's Exhibits will be identified as DX——;
The trial transcript will be referred to by the witness and page number, e.g. —— Tr. ——;
The patent in suit is PX 1.

Appendix A

The Patent in Suit

The Fisch patent was issued on June 9, 1964, and relates to the production of metallized effects in extruded transparent thermoplastic products. It is a process patent. 35 U.S.C. §§ 100, 101.

The thermoplastic extrusion process of the invention produces a decorative trim or strip, having a metal foil, such as aluminum, encased in a transparent thermoplastic. The product is in widespread use as trim on automobiles, home appliances and the like, and as decorative trim on cabinets where, because of a bend in the trim around a particular radius, an all metal trim could not be used because of buckling.

In the thermoplastic extrusion process of the invention, a molten thermoplastic material and a metal foil, having been introduced into an extrusion apparatus, are forced through a die. The thermoplastic material is melted to a molten state at high temperature so that it is in a fluid condition capable of being forced through the die. The extrusion emerges from the die with the metal object encased in the plastic. Then it is cooled, which apparently solidifies, sets or hardens the thermoplastic material. The extrusion has the cross-sectional shape of the die opening. Insofar as these elements are concerned, plaintiff concedes anticipation and non-obviousness in view of the prior art (See PX-1, Col. 1 as to the extrusion process and Col. 2 as to the extrusion apparatus).

Thus, prior to filing of the Fisch patent application, such extrusions of plastic strips with metal foil encased therein were being produced and sold. Plaintiff contends, however, that the resultant product had substantial defects, in that, with bending and outdoor exposure, there occurred wrinkling and distortion of the metal foil within the plastic, and I so find.

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For a year and a half, plaintiff's employees tried without success to solve the problem, until, by the process of the Fisch patent, the wrinkling of the foil was eliminated. The foil used in the patented process is pre-coated on at least one of its surfaces with a thin, film-like coating of a transparent thermoplastic lacquer of the group consisting of cellulose nitrate, cellulose butyrate, ethyl cellulose and polyvinyl acetate-polyvinyl chloride lacquers. This lacquer coated foil is fed into a die in unison with the thermoplastic material and the transparent thermoplastic material is extruded about the lacquer coated foil. The surface of the foil containing the lacquer coating contacts the interior surface of the extruded material and the lacquer coating on the foil adhesively fixes the position of the foil with respect to the extruded transparent thermoplastic material.

Plaintiff's use of the process, to extrude and make products with a lacquer coated foil, resulted in the cessation of complaints from customers that the foil was wrinkling and the products were discoloring.

The Fisch patent contains 5 Claims; and Claims 1, 2, and 3 are charged to be infringed by defendant's process. They are as follows:

> 1. In the process of preparing extruded thermoplastic products with at least one visible region thereof having a metallic appearance, the steps comprising
>
> providing a metal foil having a thin, film-like coating of a transparent thermoplastic lacquer of the group consisting of cellulose nitrate, cellulose butyrate, ethyl cellulose, and polyvinyl acetate-polyvinyl chloride lacquers on at least one surface thereof.

extruding a transparent thermoplastic material about the lacquer-coated foil while feeding the foil in unison with the thermoplastic material with the surface of the foil containing the lacquer coating contacting the interior surface of the extruded material whereby the lacquer-coating of the foil adhesively fixes the position of the latter with respect to the extruded material.

2. The process as set forth in claim 1 in which the metal foil is an embossed foil containing a multiplicity of facets adapted to reflect light in various directions.

3. The process as set forth in claim 1 in which the metal foil comprises a layer of said thermoplastic lacquer on the surfaces of both sides thereof and in which the thermoplastic material is extruded to contact both lacquer-coated sides of said film.

As can readily be seen, Claims 2 and 3 are actually dependent upon Claim 1. In addition to the recitations of Claim 1, Claim 2 recites that the foil is embossed. Claim 3, in addition to the recitations of Claim 1, recites that the foil is coated on both sides with the lacquer and that the thermoplastic material is extruded to contact both sides of the foil.

In summary, it can thus be said that involved herein are two technologies, both of which, plaintiff concedes, were known and used before its invention. These two technologies are combined by the Fisch patent to provide a process of preparing extruded thermoplastic products with at least one visible region thereof having a metallic appearance. The first of said technologies is the extrusion of thermoplastic materials. These materials, when heated,

become plastic or soft, and can be molded or shaped into desired configurations; and, when cooled, are capable of hardening and being fixed in the desired molded configuration. These thermoplastic materials, when heated and soft, can be extruded or forced through an extrusion die and, when so extruded and then cooled, are capable of hardening and being fixed in the shape formed by the extrusion or extrusion die. The second of the technologies, brought together with the first, and combined to provide the process of the invention of the Fisch patent, it the coating of a surface with a lacquer. Plaintiff acknowledges that the technology of applying thin, film-like coatings of lacquers to surfaces, including metal surfaces, was known prior to the invention of the Fisch patent.

In combining the technology of the extrusion of thermoplastic materials with the technology of applying thin, film-like coatings of lacquers to surfaces, Fisch discovered that, to accomplish the purposes of the patent, including avoiding of wrinkling, particular lacquer coatings on one or more of the surfaces of the metal foil should be used. Thus, the patent prescribes that the lacquer should be a "thermoplastic adhesive" (Patent, Col. 1); "must be one which is capable of absorbing or overcoming the non-adhesive effects of the lubricant film" on the foil (Patent, Col. 2); "Very satisfactory adhesives which act as adhesives between the foil and plastic in spite of the residual lubricant or oil on the foil are lacquers with a nitrocellulose base. Cellulose butyrate lacquers and vinyl acetate-vinyl chloride copolymer lacquers are also satisfactory" (Patent, Col. 2); "The foil 21-5 is coated with a thin layer of adhesive lacquer 26-5 which may have a base of cellulose butyrate, cellulose nitrate, ethyl cellulose, polyvinyl acetate-polyvinyl chloride" (Patent, Col. 3).

For a better understanding of the issues, defendant's position, to be analyzed hereinafter in association with its

proffered prior art, should be stated now. Defendant argues (Def's Post-Trial Brief, pp. 17-18):

> In essence, claim 1 of the suit patent is a *combination claim* for a process for preparing extruded thermoplastic products by a combination of the following two steps: *Combination Step 1: Providing a metal foil having* a thin film-like *coating* of a transparent thermoplastic *adhesive lacquer* including cellulose nitrate, ethyl cellulose or polyvinyl acetate—polyvinyl chloride lacquers. *Combination Step 2: Extruding a transparent thermoplastic material about the adhesive lacquer coated foil feeding* the foil in unison with the thermoplastic material so that the lacquer adhesively affixes the foil to the thermoplastic material.
>
> The only difference between the disclosure of the prior art Shanok patent (DX-Q) and the two steps of the process of combination claim 1 in the suit patent is that the *selected* metal foil *provided* is coated with specified adhesives lacquers prior to the extrusion step (PX-6 A, B and C; Bruins Tr. 303-305, 407; Skeist Tr. 642, 648). Further, Step 1 is not a process step but instead is a *selection* step to provide a metal foil precoated with certain adhesive lacquers for use in the claimed process.
>
> Metal foil coated with the identical adhesive lacquers set out in claim 1 were conventional commercial products prior to the filing of the application for the patent in suit (DX-X, DX-Z, DX-BV; Skeist Tr. 630-631). In addition, ethyl cellulose, cellulose nitrate and vinyl acetate—vinyl chloride copolymers were well-known conventional commercial adhesives and known in the prior art for use in bonding metal foil to transparent thermoplastic material (Bruins Tr. 300-302, 336-337; Skeist Tr. 628-629, 685-688).

> Thus, the record is clear that there is no new element or step in combination claim 1 of the patent in suit. [Emphasis in original]

As to Claims 2 and 3 defendant contends (Def's. Post-Trial Brief, p. 27):

> Combination claim 2 adds the limitation of the use of an embossed foil to the subject matter of the combination claim 1 and combination claim 3 adds the limitation of the use of the adhesive lacquer on both sides of the foil to the subject matter of combination claim 1. The record is devoid of any evidence that the use of embossed foil or foil with lacquer on both sides adds anything of patentable significance to the subject matter of claim 1.

Defendant then concludes the statement of its position (Def's. Post-Trial Brief, p. 27):

> Accordingly, as the selection of the named adhesive lacquers for coating foil for use in the process of the Shanok patent (DX-Q) would be an obvious solution to the problem of separation or delamination in the product, and as no new result or function is achieved, claims 1, 2 and 3 are invalid for obviousness.

Defendant's division of the Fisch patented process into two steps is consistent with plaintiff's positon. *See* Pff's. Proposed Findings of Fact and Conclusions of Law 22:

> The invention of the patent in suit solved the wrinkling problem by the process of providing a metal foil having a thin, film-like coating of a particular transparent thermoplastic lacquer. In the second step of the process, the transparent ther-

moplastic material is extruded in unison with the lacquer coated foil (Rothman Tr. 112).

Validity of the Patent

Defendant contends the patent in suit is invalid for the following principal reasons:

1. Because the process of the patent is not new in light of the prior art, under 35 U.S.C. § 102.

2. Because the differences between the subject matter of the invention and the prior art are such that the subject matter as a whole would have been "obvious" at the time the invention was made to a person having ordinary skill in the art to which the subject matter of the invention pertains, under 35 U.S.C. § 103.

3. Because the patent in suit does not adequately disclose how to make and use the invention, under 35 U.S.C. § 112.

Other reasons are also advanced and will be discussed herein as appropriate.

Presumption of Validity

Section 282 of 35 U.S.C. provides:

> A patent shall be presumed valid. The burden of establishing invalidity of a patent shall rest on a party asserting it.

The burden of overcoming the presumption of validity is a substantial one. As noted in *Trio Process Corp.* v. *L. Goldstein's Sons, Inc.*, 461 F.2d 66, 70 (3d Cir.), *cert. denied*, 409 U.S. 997 (1972):

Appendix A

Congress provided in 35 U.S.C. § 282 (1970), that: "A patent shall be presumed valid. *** The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting it." And this Court has recognized that "* * * the burden of proving invalidity in the face of the presumption is a heavy one." Schmidinger v. Welsh, 383 F.2d 455, 462 n. 10 (3d Cir. 1967); cert. denied, 390 U.S. 946, 88 S.Ct. 1031, 19 L.Ed.2d 1134 (1968). Indeed, invalidity must be demonstrated by clear and convincing proof, Ever-Wear Inc. v. Weiboldt Stores, Inc., 427 F.2d 373 (7th Cir. 1970); General Foods Corp. v. Perk Foods Co., 419 F.2d 944 (7th Cir. 1969), cert. denied, 397 U.S. 1038, 90 S.Ct. 1537, 25 L.Ed.2d 649 (1970); Moon v. Cabot Shops, Inc., 270 F.2d 539 (9th Cir. 1959), cert. denied, 361 U.S. 965, 80 S.Ct. 596, 4 L.Ed.2d 546 (1960).[2]

Plaintiff claims this presumption is particularly strong in that, while the Patent Office Examiner considered and

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[2] In Carter-Wallace Inc. v. Davis-Edwards Pharmacal Corp. 443 F.2d 867, 871 n. 4 (2d Cir. 1971) it was stated:

> The presumption of validity accorded a patent regularly issued, referred to in the quoted passage and long recognized in judicial precedent, see, e.g., Radio Corp. of America v. Radio Engineering Laboratories, Inc. 293 U.S. 1, 7-8, 55 S.Ct. 928, 79 L.Ed. 634 (1934), was codified in 1952, 35 U.S.C. § 282. The Reviser's Note states: "The first paragraph declares the existing presumption of validity of patents." We have recently noted that the presumption "has no independent evidentiary value; rather, it serves to place the burden of proof on the person who asserts invalidity. Reasonable doubt on the issue of validity must be resolved in favor of the patent holder, but in the usual case a preponderance of the evidence determines the issue." Rains v. Niaqua, Inc., 406 F.2d 275, 278 (2 Cir), cert. denied, 395 U.S. 909, 89 S.Ct. 1751, 23 L.Ed.2d 222 (1969).

applied each of defendant's theories of prior art obviousness, the patent was ultimately granted by the unanimous decision of three senior Examiners constituting the Board of Appeals (*See* PX-3). Since the Board of Appeals is the highest examining tribunal of the Patent Office, plaintiff argues that its action thus strengthens the presumption of validity, citing *Otto* v. *Koppers Co.*, 246 F.2d 789, 800-01 (4th Cir. 1957), *cert. denied*, 355 U.S. 939 (1958).[3]

On the other hand, it is well settled that the presumption of validity does not exist if, as defendant argues was here the case, there is shown to have been appropriate

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[3] Plaintiff also points out that one of the members of the Board of Appeals who granted the patent in suit was P. J. Frederico, "a recognized authority, whose Commentary On The New Patent Act is the official preface appearing in Volume 35 of United States Code Annotated." Pff's Post-Trial Brief, p. 11.

Actually, as the File Wrapper discloses, the application for the patent in suit was filed on February 20, 1957, and was rejected by the Examiner on four separate occasions, culminating in a final rejection dated May 25, 1961 (PX-3, pp. 19, 25, 32 and 51). On appeal to the Patent Office Board of Appeals, only two prior art references were relied on to support the Examiner's rejection, namely, the Shanok patent (PX-3, p. 83 and DX-Q) No. 2,774,811 and the Chadbourne patent (PX-4M and DX-N) No. 2,669,754; however, in the four rejections at least twenty prior art references had been considered. In the decision of the Board of Appeals the only references considered were the Chadbourne and Shanok references.

The Board of Appeals allowed the application for the patent in suit over the Examiner's rejection because the references relied on did not disclose the use of a lacquer coated foil as follows (PX-3):

> Claims 2 and 11 to 14, directed to the process, stand rejected as being unpatentable over Shanok et al. in view of Chadbourne. We have carefully considered the Examiner's views, but we will not sustain this rejection. Neither one of these references nor their combination discloses extruding a thermoplastic material about a lacquer coated foil for the purpose of solving the problem of non-uniform adhesion and wrinkling.

prior art references which were not considered by the Patent Office. *Hadco Products Inc.* v. *Walter Kidde & Co.*, 462 F.2d 1265, 1272 n. 33 (3d Cir.), *cert. denied*, 409 U.S. 1023 (1972); *Philips Electronic and Pharmaceutical Industries Corp.* v. *Thermal and Electronics Industries, Inc.*, 450 F.2d 1164, 1176 (3d Cir. 1971); *T. P. Laboratories, Inc.* v. *Huge*, 371 F.2d 231, 234 (7th Cir. 1966); *cf. Hunt* v. *Armour & Co.*, 185 F.2d 722 (7th Cir. 1951).

It is against the background of these pertinent principles that the validity issue will now be considered.

Novelty

I shall deal first with the question of novelty. Title 35 U.S.C. § 102 provides:

> A person shall be entitled to a patent unless—
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or
>
> • • •
>
> (g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

Appendix A

For the defense of lack of novelty under 35 U.S.C. § 102 to prevail, the claimed invention must be disclosed within the four corners of a single prior art patent or other single piece of prior art. *Package Devices, Inc.* v. *Sun Ray Drug Co.*, 432 F.2d 272, 275 (3d Cir. 1970), *cert. denied*, 401 U.S. 956 (1971); *Ling-Temco-Vought, Inc.* v. *Kollsman Instrument Corp.*, 372 F.2d 263 (2d Cir. 1967); *Skelly Oil Co.* v. *Universal Oil Products Co.*, 31 F.2d 427 (3d Cir. 1929); *cf. St. Regis Paper Co.* v. *Tee-Pac, Inc.*, 352 F.Supp. 309 (N.D. Ohio 1973).

The only prior art reference asserted by defendant in support of its § 102 defense is the Nadeau patent (DX-A1), issued on August 3, 1954, on an application filed May 3, 1952. The Fisch patent process is a hot melt extrusion process, and, I find, plainly different from that of Nadeau. In Fisch, as has been stated, the thermoplastic material is heated, melted and forced through the extruder die in unison with lacquered aluminum foil. The aluminum foil goes through the die opening along with the hot thermoplastic. The temperature of the hot, melted thermoplastic, as it is fed through the die, is about 400° F.; and, after leaving the die, the melted thermoplastic, with the foil embedded therein, is quenched and cooled to room temperature.

The Nadeau patent process, which was not before the Patent Office, is directed to the preparation of a photographic printing plate involving the coating of various layers of material on a plate of aluminum followed by acid treatment, etching and sensitizing of the photographic surface, for use in a printing press.

Nadeau says little of extrusion. In Column 10 of the patent, Nadeau refers to various techniques that can be employed at room temperature for applying the coatings to his aluminum plate, and, in addition to room temperature spraying and dipping, Nadeau mentions extrusions. The

testimony persuades me that the extrusion was vastly different from that of the Fisch patent. Thus, I accept the testimony of plaintiff's expert, Professor Bruins, that the Nadeau patent was concerned with solvent extrusion at room temperature to lay down a coating; that Nadeau means "not molten extrusion, but merely toothpaste, room temperature extrusion"; and that the aluminum foil in the process of the Nadeau patent does not go through the die head of the extruder.

Nor can I engage in a restricted reading of the claims in suit, as defendant would have me do, so as to ignore that they deal with hot melt extrusion. That this knowledge is drawn from the patent specification and not the bare language of the claims does not vitiate it. As the United States Supreme Court stated in *United States* v. *Adams*, 383 U.S. 39, 49 (1966):

> . . . it is fundamental that claims are to be construed in the light of the specifications and both are to be read with a view to ascertaining the invention . . . .

Accordingly, I find that the prior art Nadeau patent does not within its four corners disclose the process invention of the patent in suit, and that said invention was not anticipated under § 102.

Obviousness

Defendant argues that the Claims 1, 2 and 3 are invalid for obviousness. Section 103 of Title 35 provides in pertinent part:

> A patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having

ordinary skill in the art to which said subject matter pertains. . . .

In *Trio Process, supra,* 461 F.2d at 70-1 Judge Adams discussed the *Graham* v. *John Deere* prescription for determining obviousness, and its application, as follows:

> Although Section 103 was enacted in 1952, it was not until 1966 that the Supreme Court definitely construed it in a trilogy of cases. *Graham* v. *John Deere Co.,* 383 U.S. 1, 86 S.Ct. 684, 15 L.Ed. 2d 545 (1966); *Calmar, Inc.* (Colgate-palmolive Co.) v. *Cook Chemical Co., id.; United States* v. *Adams,* 383 U.S. 39, 86 S.Ct. 708, 15 L.Ed. 2d 572 (1966). In *Graham,* the Supreme Court set forth the primary tests and secondary criteria for determining obviousness:
>
> > "[T]he scope and content of the prior art * * *; differences between the prior art and the claims at issue * * *; and the level of ordinary skill in the pertinent art * * *. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented." 383 U.S. at 17, 86 S.Ct. at 694. [footnote omitted]

It is thus incumbent upon the trial court to consider the three primary tests of obviousness and make the requisite findings. *Trio Process, supra,* 461 F.2d at 71. The "secondary considerations" may or may not require evaluation.

It is not without significance that at issue here is a combination patent. In *Hadco Products, Inc.* v. *Walter Kidde & Co., supra,* dealing with a design combination patent, Judge Forman wrote (462 F.2d at 1269):

> . . . Under § 103 it must be determined that the differences between the prior art and the subject matter

> of the patent are nonobvious to a worker of ordinary skill to justify the issuance of a patent. The courts are bound to a "strict observance" of this rigorous standard.
>
> Where, as in the present case, a combination patent is involved, additional aspects of non-obviousness come into play. The court must "scrutinize combination patent claims with a care proportioned to the difficulty and improbability of finding invention in an assembly of old elements." Such a patent must create a synergistic effect, one in which the combination of elements results in an effect greater than the sum of the several effects taken separately." [footnotes omitted]

As to the "rigorous standard" referred to, the opinion stated (462 F.2d at 1269 n. 17):

> . . . This standard, of course, neither diminishes the presumption of validity which attaches to a patent . . . nor lessens the burden of the party challenging a patent to prove its invalidity. . . .

As to the "combination" rule, it is noted that in the same term as *Graham,* the Supreme Court found a combination patent for a battery was nonobvious because it produced "unexpected" results. *United States* v. *Adams,* 383 U.S. 39, 51 (1966). *See also Henkels & McCoy, Inc.* v. *Elkin,* 455 F.2d 936 (3d Cir. 1972); *Devex Corp.* v. *General Motors Corp.,* 467 F.2d 257, 258 n. 2 (3d Cir. 1972), *petition for cert. filed,* 41 U.S.L.W. 3592 (U.S. May 18, 1973) (No. 72-1161):

> It is familiar learning that in the combining of old and familiar elements the achievement of an unexpected result is needed and may suffice to make the combination patentable. . . .

See also, for application of the "combination" rule to process patents, *Sperti Products, Inc.* v. *Coca-Cola Co.,* 339 F.2d 607, 609 (3d Cir. 1968); *Southwest Products Co.* v. *Heim Universal Corp.,* 443 F.2d 621, 624 (2d Cir. 1971); *Proler Steel Corp.* v. *Luria Brothers & Co.,* 417 F.2d 272, 278 (9th Cir. 1969).[4]

Prior Art

In *Trio Process Corporation* v. *L. Goldstein's Sons, Inc., supra,* Judge Adams wrote (461 F.2d at 69 n. 3):

Prior art has been defined as follows:

> "The existing state of knowledge in a particular art at the time an invention is made. It includes the issued patents, * * * publications, and all other knowledge deemed to be common thereto such as trade skills, trade practices, and the like, A. Smith, Patent Law Cases, Comments and Materials 2 (1964)."

See also Graham v. *John Deere Co., Supra,* 383 U.S. at 35.

The prior art must be examined against the following background: Plaintiff combined two processes, both of which were admittedly known, that is, thermoplastic extrusion and lacquer coating of aluminum foil. Additionally,

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[4] Judge Forman, in *Hadco* (462 F.2d at 1274 n. 47), stated:

"In the recent case of Trio Process Corp. v. L. Goldstein's Sons, Inc. . . . clearly distinguishable from the present case, this court sustained a process patent which consisted of a combination of steps known in the art, reasoning that, "the essence of the Spitz invention did not lie in the individual steps, but rather, consisted of combining the steps in an unsuggested manner into a process that would achieve a substantially different function and result from the other processes of which the individual stages were a part. (footnote omitted). Where such occurs, the invention of a process may be patentable despite the fact that the individual phases were known in the art."

encapsulating of aluminum foil within the thermoplastic extrusion was known. Finally, the apparatus used, a typical extrusion device, was also well known. What is contended to be at the core of the Fisch invention is a recognition of a problem of wrinkling of the foil within the encapsulating plastic, and solution of that problem by hitting upon the use of a certain lacquer as a thin coat or film upon at least one surface of the foil before introducing it into the extrusion apparatus.

The subject of appropriate prior art is in this case peculiarly complex. It is best dealt with by commencing with the prior art applied in the Patent Office.

As has been stated, there were four separate rejections before the Board of Appeals allowed the claims, the validity of which are challenged (Footnote 3, supra).

As the File Wrapper discloses, Claims 1, 2 and 3 of the patent in suit vary somewhat from the Claims originally submitted (PX-3, p. 12), which read as follows:

> 1. In the process of preparing an extruded thermoplastic product with at least one visible region having a metalic appearance, the steps comprising providing a metal foil comprising at least one layer of thermoplastic adhesive adapted to adhere to thermoplastic material to be extruded, and extruding a thermoplastic material about said foil while feeding the foil through the extrusion device with the surface of the foil containing the thermoplastic adhesive immediately beneath the extruded thermoplastic region which is to be provided with a metal appearance.
>
> 2. The process as set forth in claim 1 in which the metal foil is an embossed foil containing a multiplicity of facets adapted to reflect light in various directions.

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3. The process as set forth in claim 1 in which the laminated metal foil comprises an adherent layer of thermoplastic material on both sides thereof adapted to adhere to the thermoplastic material extruded on both sides.

To these on October 31, 1957, the Examiner responded, in pertinent part, as follows (PX-3, pp. 20-21):

> (7) Claims 1-4 are further rejected as being unpatentable over Flint, Duffy, Cook Jr. or Perzel. It would be obvious to one with ordinary skill to put an adhesive aid on the surfaces of the foils of either of the references wherever found necessary to get good adhesion, just prior to the steps of extruding an adhesive covering on a foil as shown by each reference. In any event Flint shows such use of an adhesion aid. It would also be obvious to impose whatever designs are desired to be seen upon a foil to be visible through a transparent covering such as shown by Flint. Apparatus limitations claimed, do not distinguish over the process of passing a foil through an extruder die, shown by the references.

By letter dated April 3, 1958, the applicant wrote in part as follows (PX-3, pp. 22-23):

> Reconsideration of the rejection of claims 1-4 as being drawn to the obvious method of making the article is requested. In the article, the adhesive coat could be applied first to the plastic portion or to the foil or as a separate extrusion layer, etc. Where at least three variations of a process are possible to produce an article, it is not seen that there is proper basis for deciding that the method suggested by applicant is the obvious one.

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Reconsideration of the rejection of claims 1-4 on Flint, Duffy, Cook, Jr., or Perzel is requested. None of the patentees have had the problem solved by applicant. All of these patents show the idea of extruding a thick metal strip (or fabric in the case of Cook) which is not capable of being crimped or bent by the plastic material extruded around the same. Adding an adhesive to the strips of Flint, Duffy, Cook or Perzel would have no effect on the extruded product. If it is attempted to incorporate a foil instead of a strip or fabric into the extrusion products of said references, the effect is not satisfactory because of the wrinkling of the foil. That this undesirable effect could be overcome by coating the foil with an adhesive is not obvious nor is it suggested by the references. Indeed one might logically conclude that quite the opposite effect would take place since the adhesive coating on the foil makes it more sticky and increases the friction of the foil against the sides of the passages through which it must be fed in the extrusion process. No idea of applying an adhesive is found in Flint. This latter patent does refer to a "sealing" liquid but this is not an adhesive. Instead it is a liquid adapted to seal the opening 34, 36 against admission of air to the interior of the plastic extrusion product. The acetone employed as the "sealing" liquid is not an adhesive.

Another Examiner then disallowed the claims on November 19, 1958, writing in part as follows:

Claims 1, 3 and 5 are rejected as unpatentable over either McCowen or Chadbourne, each alone or each in view of Shanok et al or vice versa. The

step of extruding a thermoplastic synthetic resin about an adhesive coated metal base is old in each of the primary references. A metal foil base specifically would be obvious in view of Shanok et al.

Claims 2 and 6 are rejected as unpatentable over the references applied above in the rejection of claim 1 in view of either Libberton or Degman who provide a corrugated metal core, note Fig. 8 in Libberton and Fig. 2 in Degman.

By Amendment filed May 11, 1959, the applicant amended the language of Claims 1 and 3 almost to what they now read and stated (PX-3, pp. 28-30):[5]

Reconsideration of the rejection of claims 1, 3 and 5 as unpatentable over McCowen or Chadbourne alone or in view of Shanok et al is requested. It is believed that this rejection depended more on an interpretation of the language of the claims than on an actual showing of applicant's process. The claims have accordingly been amended to more clearly define the invention. In McCowen a relatively stiff metal core is coated *by* extrusion and not *before* extrusion with a relatively *thick* layer of thermoplastic material. The process of this reference has no obvious application with foils. The preliminary coating applied by extrusion in the processes of McCowen is not for the purpose of providing

[5] The applicant's submission read (p. 1, lines 9-16):

When it was attempted to obtain a metal-like appearance in a plastic extruded product by embedding a metal foil therein, however, it was found that the inserted foil wrinkled so as to give the effect of an inferior product such as might be caused by distortion of the plastic or foil during extrusion or subsequent bending or flexing or by only loosely associating the foil with the plastic.

an adhesive for the next applied layer. The polyethylene of McCowen is at most translucent and it would be completely opaque with any substantial proporation of metal particles.

In McCowen the first layer 12 insulates the wire 1 from the metal containing layers 10 and 11. Chadbourne discloses a cable composed of composite strands each of which is coated with nylon (in Fig. 4, the only figure which applies to this case). Nylon being an opaque or at most translucent material is not covered by applicant's claims and it is obvious that patentee is not concerned with the problem of producing a product with a metallic aspect or in preventing wrinkling of the core material. In Chadbourne, the nylon coating 19 on the core strands 17 appears to be for the purpose of insulating the strands from each other and not to provide additional adhesion; nothing in the patent disclosure would lead one to believe that the coatings 14 and 24 of Figs. 3 and 5 are not just as adherent as the coating 20 of Fig. 4.

The process of Shanok et al is not essentially different from the process disclosed on page 1, lines 9-16. The problem of wrinkling of foil in such a process is an acute one which has not, to the best of applicant's knowledge, been solved by their competitors who use the process disclosed in Shanok et al. It is not obvious from the disclosures of McCowen or Chadbourne to apply a thin film of adhesive to a thin metallic foil before extruding plastic about the same for the sole purpose of preventing wrinkling of the foil in the extruded product. The most obvious explanation of the cause of wrinkling is that it is due to the contraction of the embedding plastic during cooling. Coating the

> foil with adhesive does not change the co-efficient of expansion of the plastic in the least but it does prevent wrinkling. It is submitted that this is a rather remarkable result which could not be predicted from a study of all of the references of record. [emphasis in original]

On February 23, 1960, another Examiner rejected the application, stating (PX-3, p. 32):

> Claims 1, 3, 5 and 7 are rejected as unpatentable over either McCowen or Chadbourne, each in view of Shanok et al. The steps as claimed are clearly old in each of the primary references. Nylon surface (19) in Chadbourne and coating (12) in McCowen constitute a coating prior to the extruded coat. Chadbourne also feeds a metal core through the extrusion device. A metal foil core is deemed an obvious modification in view of Shanok et al.
>
> Claims 2 and 6 are rejected as unpatentable over the references applied above in the rejection of claim 1 in view of either Libberton or Degman for the reasons of record.

Again, on August 11, 1960, applicant requested reconsideration of the rejection, distinguishing McCowen and Chadbourne as involving a cable as a core material, and thus not presenting the problems of extrusion of a thin foil. In McCowen, the pre-coated cable is embedded in plastic by a laminating process in which preformed sheets are pressed against the pre-coated core. As to Chadbourne, which discloses a process in which cable strands are precoated with nylon, the core material is pulled through a nozzle at a faster rate than the nylon coating is extruded so that the nylon is stretched in the process, thereby improving adhesion. The foil of the Fisch patent could not

be used as the core in Chadbourne's process. Moreover, Chadbourne does not show any method of avoiding wrinkling during the precoating operation.

Applicant also reiterated its basis for distinguishing Shanok.

On May 26, 1961, another Examiner "finally" rejected Claims 1, 2 and 3 of the Fisch application "as unpatentable over Shanok et al in view of McCowen or Chadbourne. . . ." (PX-3, p. 52).

On November 16, 1961, the applicant filed another amendment, for the first time referring to a "thin, film-like coating of a transparent thermoplastic lacquer of the group consisting of cellulose nitrate, celloulose butyrate, ethyl cellulose, and polyvinyl acetate-polyvinyl chloride lacquers on at least one surface thereof. . . ."

The amendment letter referred to a conference on October 3, 1961, between the applicant's representatives and the Examiner, at which applicant demonstrated the strength of the bond obtained between the foil and the plastic covering was demonstrated and compared with the lack of bonding between foil and plastic obtained by the conventional extrusion process.

On November 28, 1961, the Examiner denied entry to the November 16, 1961, amendment (PX-3, p. 64), and thereafter the applicant appealed to the Board of Appeals. It rewrote Claims 1 and 3 to their present form and, in its Brief, stated (PX-3, p. 71):

> . . . This invention is based on the discovery that the embedded foil may be made to adhere to the inner wall of the thermoplastic material which is extruded around the same if the foil is first coated with a thin layer of a transparent thermoplastic lacquer. When a foil coated with a thin layer of transparent, thermoplastic lacquer is extruded with a thermo-

> plastic material, almost instant adhesion between the foil and the thermoplastic extrusion material takes place on contact and the foil is bonded within the extrusion product in permanent, wrinkle-free condition. The bond between the foil and the thermoplastic is not disturbed by cutting or bending the product.

Applicant once again distinguished Shanok, Chadbourne and McCowen. In view of defendant's reliance upon Shanok as prior art in this suit, the applicant's statement to the Board of Appeals on Shanok is set forth in full, as follows (PX-3, pp. 75-8):

> Shanok et al does not disclose any particular extrusion steps or apparatus and his product cannot be any better than the product obtained by conventional extrusion processes. The showing of the cross-section of patentees antenna in the drawing thereof is an idealized or, at most, a diagrammatic showing. In actual practice, there is always a layer of air between the uncoated foil and the thermoplastic material surrounding the same in any such product prepared by conventional extrusion methods. At the interview with the Examiner referred to in the amendment of November 9, 1961, it was demonstrated that the non-coated foil embedded in plastic by conventional methods was clearly not adhered to any surface of the plastic and that it could be readily stripped from the surface thereof once a portion of the plastic is removed to permit access to the foil. On the other hand, it was shown that applicant's foil, coated on one side with the lacquer, could not be removed from the plastic to which this side is adhered. It was also demonstrated that

neither cutting or bending even the complex shapes of composite extrusions made by applicant's process does not cause separation of the foil from the plastic.

What applicant obtains by the lacquer coating and one extrusion cannot be obtained by two extrusions or two plastic molding steps such as shown by McCowen and Chadbourne. Consider the prior art specimen of Exhibit A of applicant's affidavit filed with the amendment of August 29, 1960, for example. What possible good could be accomplished by extruding or pressing another layer of thermoplastic over the thermoplastic layer of this Exhibit. Extruding just does not produce a union between the plastic and the foil.

In embedding a foil in a plastic, it must be remembered that the foil is easily bent, wrinkled or torn and is of limited tensile strength; it cannot be pulled through the extrusion orifice (as is the wire of Chadbourne) and it cannot be subjected to pressure from the plastic during or prior to extrusion. It is indeed surprising to find that applicant's lacquer-coated foil is adhered to the surrounding plastic throughout its entire lacquer coated surface. It is believed that an expert in plastic extrusions might predict that the lacquer-coated foil of the present invention would unite with the plastic extruded around the same at certain spaced areas but he would not predict that it would solve the problem presented by the defects shown in Exhibit A. The tenacity with which the foil is held by the plastic (as demonstrated to the Examiner) is not predictable and it is well known that a composite product with adhering layers has superior mechanical properties to a composite product in which the layers do not adhere to each other.

* * *

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None of the references disclose the essential feature of applicant's process or product, the lacquer-coated foil. Applicant's requirement of the lacquer coated foil is an unusual, unobvious and significant extra step when considered with extrusion processes and products. Yet this step, which is not shown in the prior art, provides a most unusual and advantageous result and solves the problem of film wrinkling while at the same time producing a product with better mechanical properties due to the strong adhesion between the foil and the surrounding plastic.

The Examiner's Answer relied upon only two references, Chadbourne and Shanok, and stated the invention as follows (PX-3, p. 84):

> The invention herein resides in the fact that in the prior art some thermoplastic materials when extruded about a metal foil do not adhere well thereto. The lack of adhesion in certain areas results in wrinkling of the foil when the plastic contracts. Additionally, working the extrusion coated article results in rupture of whatever bond there is between the plastic and foil.
>
> Apparently, the lack of adhesion is due to a residual oil film on the foil which the thermoplastic fails to penetrate. See specification, page 3, last paragraph, page 4, first paragraph. The alleged invention herein is deemed to be in discovering a specific group of thermoplastic coatings which do penetrate the residual oil film and bond well to an aluminum foil as well as to a specific thermoplastic surface coating, or main body, namely, cellulose acetate.

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Thereafter, the Examiner specifically and analytically detailed why Shanok and Chadbourne made the Fisch invention obvious (PX-3, pp. 84-89).

The Board of Appeals stated (PX-3, pp. 102-103):

> The subject matter of the contended invention relates to a composite extrusion product of thermoplastic material and metal foil and to the process of producing it. The process involves coating a metal foil with a thin film of a transparent thermoplastic lacquer which serves as an adhesive layer between the foil and the thermoplastic material and which is particularly useful in overcoming nonadherence of the thermoplastic material due to the presence of residual amounts of lubricants or oil on the surface of the foil.

Dealing with "Claim 11" (now Claim 1 in suit) the Board stated (PX-3, p. 103):

> Claims 2 and 11 to 14, directed to the process, stand rejected as being unpatentable over Shanok et al. in view of Chadbourne. We have carefully considered the Examiner's views, but we will not sustain this rejection. Neither one of these references nor their combination discloses extruding a thermoplastic material about a lacquer coated foil for the purpose of solving the problems of nonuniform adhesion and wrinkling.

Thereafter the patent issued, with twenty prior art references, including Shanok and Chadbourne, listed (PX-1, Col. 6).

The issue of obviousness is thus refined as follows: whether the use of a lacquer coated foil (encapsulated within a thermoplastic material) for the purpose of solving

the problems of nonuniform adhesion and wrinkling is unobvious?

Defendant argues that the presumption of validity is weakened or destroyed in that the Patent Office failed to cite the most pertinent prior art. More specifically, defendant states that Chadbourne and Shanok miss the mark in that there is no disclosure in Chadbourne of the use of an adhesive lacquer of the types claimed in the suit patent for bonding a thermoplastic material to a metal foil; and there is no disclosure in Shanok of the use of an adhesive lacquer for bonding the metal foil and the thermoplastic. Defendant then states that its prior art is of more pertinence than Shanok and Chadbourne.

Fundamental to defendant's prior art argument is its statement, with which I shall now deal, that the wrinkling problem met by the Fisch invention was actually a problem of delamination in which the aluminum foil and the transparent thermoplastic material came apart after completion of the extrusion process. Accordingly, to adhere these elements better to each other, defendant argues, it was obvious to use an adhesive to glue them together; and defendant sees this as so clearly indicated that it makes the contention initially even without specific prior art support.

Yet this seemingly simple point was considered in the Patent Office. Indeed, in the first rejection, the Examiner said (PX-3, p. 20): ". . . It would be obvious to one with ordinary skill to put an adhesive aid on the surfaces of the foils of either of the references wherever found necessary to get good adhesion, just prior to the steps of extruding an adhesive covering on a foil as shown by each reference . . ." (citing patents of Flint, Duffy, Cook Jr. and Perzel). Indeed, over six years various Examiners considered and applied some twenty prior art references,

which included prior patents in the fields of plastics lamination and bonding and plastics extrusion.

Included as cited prior art was the Heaton patent (PX-4, tab O) which disclosed the use of nitrocellulose, one of four lacquers named in the Claims in suit, as an adhesive for bonding polyethylene to a fiber base. After an early rejection, the Examiner decided apparently that defendant's prior art adhesive theory was without merit, or at least was of less merit than the prior art represented in Shanok and Chadbourne.

The Board of Appeals, however, approved the process claims of the patent in suit because none of the prior art references disclosed "extruding a thermoplastic material about a lacquer coated foil for the purpose of solving the problems of non-uniform adhesion and wrinkling." (PX-3, p. 103).

The simplicity inherent in hindsight is often misleading.

> It is well settled that in retrospect the most creative developments often appear commonplace. The critical question is whether at the time of invention the subject would have been obvious to one skilled in the art. *Columbia Broadcasting System* v. *Sylvania Electronic Prod. Inc.*, 415 F.2d 719, 728 (1st Cir. 1969), *cert. denied*, 396 U.S. 1061 (1970).

Defendant's argument overlooks that the thermoplastic material used in the extrusion process itself had adhesive tendencies. It is understandable why one skilled in the art might not find it obvious to use in addition an adhesive to resolve the wrinkling problem. *Cf.* Def's Post-Trial Brief, p. 35.

Significant too in the overall are the conditions under which the patented process is carried out: A temperature of about 400 degrees, and at a speed that allows less than

one-half second for the hot molten thermoplastic material to make contact with the aluminum foil. Thus, the wrinkling or delamination problem was solved in the context of thermoplastic extrusion as a *process*. The problem was not simply how to prevent wrinkling or delamination in a product but, instead, how to prevent it by a manufacturing process occurring in an environment of a high speed hot melt extrusion process, inside an extruder having the temperature of an oven, followed by a suddenly tremendous drop in temperature of over 300 degrees. The plaintiff's expert testimony leads me to conclude that the thin lacquer film somehow, in the brief time before the foil and the thermoplastic pass through the die opening, forms into a bond between the foil and the hot molten thermoplastic.

It is also understandable that a person skilled in the art would not readily come to the conclusion that an adhesive would eliminate the wrinkling problem in view of the tremendous stresses set up in the extrusion process, and in the bending and flexing of the end product.

In testimony I credit and accept, Professor Bruins, plaintiff's expert, testified that it was surprising and amazing that a strong bond was formed under the conditions of the patented process. He also pointed up the unusual stresses involved: On cooling, the coefficient of shrinkage of the thermoplastic is four to seven times greater than the coefficient of shrinkage of the aluminum, creating substantial stresses between the thermoplastic material and the foil as the thermoplastic extrusion is quenched and cooled (Bruins Tr. 270-272).

Professor Bruins also testified that, when the thermoplastic extrusion is bent or flexed, a substantial stress is created between the thermoplastic material and the foil and that "it is very amazing and surprising that after bending the product made by the patented process no wrinkling occurs" (Bruins Tr. 273-274).

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The patented process did not come about readily or easily. Indeed, over 18-months plaintiff tried many solutions. These as set forth in Plaintiff's Post-Trial Brief, p. 37, were embodied in testimony which I find credible and accept:

> Air and volatiles were evacuated from the crosshead to try to draw the hot, melted thermoplastic into closer contact with the foil (Rothman Tr. 95-96). Quenching with hot water to relieve strains set up in the cooling and quenching with cold water to create a strain and to improve the bond between the foil and the thermoplastic were also tried (Rothman Tr. 97-98). The foil was treated with a flame to try to burn off residue which might be on the foil and might interfere with the bonding and, at the same time, heat the foil to a temperature which might be more compatible to creating a bond between the thermoplastic material and the foil (Rothman Tr. 98). The extruding temperature was changed to lower the viscosity of the plastic so that the thermoplastic material might flow around the foil, would be softer and might adhere better to the foil and form a better bond (Rothman Tr. 99). Attempts were made to use annealed foil to get a better bond of the plastic to the foil (Rothman Tr. 99). The surface of the foil was even roughened with a wire brush in an attempt to form a mechanical bond between the thermoplastic material and the foil (Shapiro Tr. 459).
>
> • • •
>
> Other obvious expedients tried at the time proceeded along the opposite course by providing slippage between the metal foil and the thermoplastic material to avoid wrinkling. Thus, a lubricant was applied to the foil (Rothman Tr. 96-97) and two

foils, in face to face contact to slip on each other, were tried (Rothman Tr. 99-100). These efforts also failed.

Defendant's simplistic approach also omits to mention that the process in suit explicitly refers to specific lacquers; and it is clear that there is no statement in any prior art that these four specifically referred to lacquers would solve the wrinkling problem. The skilled person in the pertinent are would be confronted by hundreds, if not thousands, of adhesives, differing as to characteristics affecting their bonding ability. *See* Skeist Tr. 826-32.

Also persuasive is the testimony by Jesse Shanok and Victor Shanok, inventors of the prior art Shanok patent heretofore discussed. They were of better than ordinary skill in the thermoplastic extrusion art. They testified that their customers complained that the plaintiff's product was superior to theirs. Their efforts, from 1957 to 1959, to ascertain the reason for the difference, were unsuccessful. Then they discovered where Anchor Plastics was obtaining its lacquer coated foil, purchased some foil from that source (Singen), and used the foil in their process. They took a license under the patent in suit.

I thus conclude that, absent covering prior art, it was not obvious to the person of ordinary skill in the pertinent art to apply one of the Fisch lacquers to the foil of the Shanok process patent prior to introducing the foil into the extrusion apparatus.[6]

Defendant prior to trial had cited some ninety prior art references. At trial it relied upon ten of them.

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[6] The Board of Appeals, when it considered the patentability of the Fisch application, had before it the entire file of the Fisch application. The Board did not ignore the significance of the thermoplastic adhesive lacquer. (PX-3, pp. 102, 103).

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It relied upon Nadeau not only for its § 102 defense but also of its § 103 defense of obviousness. As has been previously stated, Nadeau is concerned with the process of making a printing plate in which various layers of material are applied at room temperature and then acid treated, etched and sensitized. The only extrusion in Nadeau is concerned with room temperature extrusion rather than hot melt thermoplastic extrusion. There is no simultaneous passing of any aluminum foil through a die opening. The Nadeau disclosure is not in the art to which the subject matter of the invention here in suit pertains, i.e., the art of thermoplastic extrusion processes and products produced by such processes, but in the photographic or printing art. Even assuming that the man of ordinary skill in the thermoplastic art conceivably is chargeable with knowledge of prior art in the photographic or printing art, it cannot be said that Nadeau teaches anything of value in hot melt extrusion under the conditions obtaining in the Fisch process. Finally, Heaton, which was before the Patent Office, is of more pertinence than Nadeau to the bonding problem which Fisch is said to have resolved. The presumption of validity is thus not overthrown by Nadeau.

Defendant also cites Shanok as pertinent prior art, in conjunction with certain publications, including an Alcoa article (DX-X), arguing that the publications embody lists of obvious adhesives "that one would select and try in the process disclosed by the Shanok patent (DX-Q) to solve the separation problem . . ." (Def't Post Trial Brief, p. 21).[7]

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[7] Defendant's citing of Shanok and the aforesaid publications are referred to by plaintiff as defendant's "prior art adhesive theory." Actually I have dealt with this theory in discussing the treatment accorded the application in the Patent Office.

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The Alcoa article deals with laminating of sheets and wraps. My own analysis of this article leads me to credit and accept the testimony of plaintiff's expert (Bruins Tr. 432):

> This article deals entirely with the subject of lamination and gives no advice on how to make an extruded product containing aluminum foil.

Moreover, as the same expert pointed out, wrinkling is mentioned in the Alcoa article in connection with hot melt adhesives. Thus, as is stated, if hot melt adhesives are applied to aluminum foil, the article teaches that you will have wrinkling rather than avoiding it, causing said expert to state (Bruins Tr. 431):

> If the hot melt adhesive were applied to the aluminum it would cause it to be expanded, due to the higher temperature, and if you now combined it with a cold sheet in laminating, you would get wrinkling.

The next of the nine prior art references relied upon by defendant is the Modern Packaging article entitled "Aluminum Foil" (DX-Z), which, like the Alcoa article, deals with laminating sheets and wraps, and not with the extrusion process. The article refers to laminating plastic films with aluminum foil and the necessity of selecting the proper adhesive therefor. This prior art is, once again, offered as part of defendant's "prior art adhesive theory" and thus is covered by what I have hereinabove stated with respect thereto, particularly as this theory was treated in the Patent Office. I regard neither this article, nor the Alcoa publication, as being more pertinent than that considered by the Patent Office.

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The next of the defendant's prior art references is the "Paper, Film & Foil Converter" article (DX-BV). This article is concerned with methods of application and coating techniques to aluminum foil. In the extrusion process described in this article, a sheet of polyethylene is first extruded and the extruded sheet is then brought into contact with the foil, but the foil does not pass through the extruder at all (Bruins Tr. 435-436). There is no mention of a wrinkling problem, much less the answer to the problem. Defendant also relies on this prior art for its disclosure of adhesives to be used with aluminum foil. Again, however, it is for this purpose not as pertinent as that before the Patent Office. As for the extrusion process discussed, this item of prior art is less pertinent than Shanok.

The next article relied upon by defendant as prior art is the Bell System Cable Sheath article taken from "AIEE Transactions" (DX-CG) and is concerned with a telephone cable. Dr. Skeist, defendant's expert, testified that the aluminum in the production of the cable goes through an extruder crosshead (Skeist Tr. 641) but, as is clear from the article's pictures, even if this does occur, the aluminum is corrugated and a part of the cable assembly. Dr. Skeist was unable to state whether there is anything in this article that discusses a wrinkling problem and, as plaintiff points out, there is none (Skeist Tr. 819). There is no contact between the foil and thermoplastic inside the die as required in the Fisch process. Professor Bruins, plaintiff's expert, testified that the polyethylene makes contact with the aluminum foil outside of the die because "the polyethylene is applied over the cable" and is drawn down or shrunk onto the cable (Bruins Tr. 858-859). There is mention that "flooding of rubber thermoplastic cement applied over the aluminum forms a bond between the aluminum and polyethylene." This, however, again offered

under defendant's "prior art adhesive theory," is far less pertinent than the art considered, and ultimately rejected, in the Patent Office.

The next prior art reference relied upon by defendant is Shanok et al. United States patent 3,245,864 (DX-BG). Defendant has also cited Shanok et al. United States patent 2,774,811 (DX-Q) which was fully considered by the Patent Office. There is no suggestion of a wrinkling problem in either of these patents nor the solution of such a problem (Bruins Tr. 434). The fact that the inventors and patentees of these two patents tried unsuccessfully to find out why the product of the process of the Fisch patent was superior and that they switched to the process of the Fisch patent and took a license in that patent has been previously discussed.

Defendant next cites as prior art the Campbell patent (DX-AD). This patent relates to a vinyl resin coating composition, and does not suggest an extrusion process, or a thermoplastic extrusion process in which a hot melted thermoplastic material and a metal foil are extruded through an extrusion die to encase the metal foil in the extruded thermoplastic. This patent also relates to lacquers, as follows (p. 4, lines 26-29):

> ... Thus, clear lacquers containing the modified resin may be employed either as an air-drying or baked coating for aluminum and other metal foils used in packaging food products....

Once again, this prior art adhesive reference is not nearly as pertinent as that considered by the Patent Office and rejected.

Sturdevant (DX-AN) and Cox (DX-AE) are both concerned with vulcanizing rubber compositions to metallic surfaces, such as solid metal conductors in electrical wires. There is no mention of wrinkling in either of these refer-

ences, nor do they suggest extruding a transparent thermoplastic material in unison about a metal foil coated with a film-like coating of the four transparent thermosplastic lacquer materials named in the Fisch patent. As defendant's expert testified, rubber vulcanizing causes an irreversible chemical reaction, like a thermo-setting process rather than a thermoplastic process as is involved in the process in suit.

The defendant also relies upon a publication "Vinylite Plastics Elastomeric Compounds Bonding" (DX-AB). I find this prior art to be more remote than that utilized in the Patent Office, and as falling within that which has heretofore been categorized as defendant's prior art adhesive theory.

Because I find the prior art cited by defendant to be less pertinent overall than that referred to in the Patent Office, I do not perceive any diminution in the presumption of validity.

The prior art offered by defendant can thus be said to consist of several publications relating to bonding and adhesives and of Shanok and Chadborune, which teach the thermoplastic extrusion of a plastic encasing a foil uncoated with an adhesive, both of which patents were cited by the Patent Office. They of course do not reflect either the wrinkling problem or its solution.

The defendant has urged that the difference between Shanok and Chadbourne and the Fisch process, that is the solution to the wrinkling problem, would be obvious to one of ordinary skill in the extrusion art, because of the abundant mention of adhesives as contained in the several publications tendered herein by the defendant.

Non-obviousness, within the meaning of 35 U.S.C. § 103, means that the differences between the subject matter of the patent claim and the prior art relied upon are such that the subject matter of the patent claim, taken as a whole,

would not have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains.

Accordingly, under *Graham*, 383 U.S., at 17, the "level of ordinary skill in the pertinent art [is next to be] resolved." Pertinent is the following:

> In order to determine whether the claimed invention constitutes progress in a useful art for which the inventor is entitled to the reward of a patent, clause 8, § 8, art. 1, of the Constitution, we shall first inquire in what art the invention stands, and what arts, seemingly analogous or related, are outside its borders. This inquiry will be pursued along lines that distinguish not merely the physical differences in the arts but particularly the difference in their problems. *Radiator Specialty Co.* v. *Buhot*, 39 F.2d 373 (3d Cir. 1930)

The art, I fined, which is pertinent is the art of extruding a thermoplastic material about a metal foil. I do not accept the proposition urged by the defendant, that the level of ordinary skill is that of the experts called in this trial, Dr. Bruins and Dr. Skeist. From the proofs offered, I find that one of ordinary skill in the pertinent art would not have talents, as the experts did, in chemistry, or have knowledge of the many techniques applicable to the manufacturing of plastics, such as limitation. Moreover, even if his knowledge extended beyond the narrow confines of the extrusion art, I find he still would not have seen or heard any teaching or suggestion as to the solution of the wrinkling problem.

Accordingly, taking the defendant's starting point on obviousness, the Shanok and Chadbourne patents and adding to them the accretion of knowledge provided by defen-

dant's prior art adhesive theory, I find that the person of ordinary skill in the art would not have recognized that the problem of wrinkling, and distortion by bending stresses, could be cured by application to the foil of one of the lacquers included in the claims in suit.

Secondary Considerations

That the Fisch process was a valuable contribution to the art of thermoplastic extrusion about an aluminum foil is clear (*See* Shapiro Tr. 238-239). The application of lacquer is obviously a desirable step, and results in a product far superior to that of the Shanok patent. Evidence of this is found in the action of the Shanoks, when they discovered the source of the superiority of plaintiff's product. They ultimately took a license through Glass Laboratories, as did General Motors Corporation and Macoid Industries Inc.

Even more significant tribute is paid to plaintiff's process by that which is manufactured by defendant. Putting infringement questions aside for the moment, it is clear that defendant, coming into the extrusion field relatively recently in 1967, elected to manufacture and sell a product made by the accused extrusion process and using foil coated with VMCH lacquer. In this connection I find the following facts as set forth in plaintiff's Post-Trial Brief, at pp. 7-8:

> . . . In 1968, defendant experimented with extruding a thermoplastic product with foil which was not coated with a lacquer coating. Defendant decided not to produce and sell such a product extruded with unlacquered foil (Crystal deposition PX 15B, pages 10-11). This work was performed by Milton Crystal, a Dynex vice-president who was a former employee of plaintiff's licensee Glass Laboratories and also a former employee of plaintiff (Crystal deposition PX 15B, page 3; Rothman Tr. 137-139).

Instead, defendant then adopted the accused extrusion process using foil coated with VMCH lacquer (Crystal deposition PX 15B, pages 9-10, 55-57). It is described in detail in PX 11 and typical products of the accused process are in evidence as PX 13.

Defendant also hired Morton Hahn in October, 1968, then a salesman for plaintiff, Anchor Plastics, to sell the extruded thermoplastic product made by the accused process using VMCH lacquer coated foil (Crystal deposition PX 15B, pages 41, 45; Hahn deposition PX 15A, pages 7-10; Shapiro Tr. 444-448).

Defendant contended at trial that plaintiff actually uses a lacquer other than that taught by the patent. I find that this is not so. I find that plaintiff orders a vinyl chloride-vinyl acetate copolymer lacquer and that its materials are supplied under that designation (PX-23), and that there was no sufficient showing by the defendant to overthrow the inference I can and do draw that plaintiff uses a vinyl chloride-vinyl acetate copolymer lacquer, one of those taught in the patent. See *Hurwitz* v. *Shiu Yim Poon,* 364 F.2d 878, 888 (C.C.P.A. 1966).

The testimony of Dr. Skeist to the contrary was unconvincing. He concluded on the basis of his infrared test that plaintiff's lacquer contained vinyl chloride, vinyl acetate and a dicarboxylic acid and was therefore VMCH (Skeist Tr. 688-695, 749, 756-767). However, he was not an infrared expert (Skeist Tr. 750-753) and the test he ran was not a precise and scientific one (Skeist Tr. 767-772). Moreover, I found Dr. Skeist's testimony less acceptable than that of Professor Lewin, a highly qualified expert in infrared technique (Lewin Tr. 841-842; 848-849; 850-852).

By virtue of the foregoing I find the Claims in suit valid as embracing a non-obvious invention.

The Disclosure in the Patent Was Adequate Under 35 U.S.C. § 112

Section 112 provides:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Defendant contends that the specification of the patent in suit is defective in that it does not identify certain transparent thermoplastic materials which defendant contends would not work in the Fisch process. Defendant supported its position by the testimony of its expert, Dr. Skeist, who stated that the Claims in suit covered the use of any transparent thermoplastic material; but that on March 1, 1973, on the eve of trial, he had been unable to make polytheylene, polystyrene, or cellulose acetate work with VMCH lacquer coated aluminum foil (Skeist Tr. 653-664).

I reject Dr. Skeist's testimony and the conclusions he drew from his ex parte experiments. Starting with an evident bias (Skeist Tr. 784), he proceeded on a less than scientific basis using only three experiments, and the aforementioned three plastics, took only 20-30 minutes, and obviously made no earnest effort to succeed. *See* Skeist, Tr. 772-773; 775; 777; 778-779; 780-781; 782-784; 788-789; 790-791.

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Applicable is the following from *Ansul Co.* v. *Uniroyal, Inc.*, 448 F.2d 872, 878 (2nd Cir. 1971), *cert. denied*, 404 U.S. 1018 (1972):

> . . ."the necessity for conducting experiments or preliminary tests to determine the successful application of an invention * * * will not invalidate a patent provided one skilled in the art could determine and select the necessary experiments or tests without unreasonable difficulty.". . .

See also, Trio Process Corp., supra, 461 F.2d at 74; *Noll* v. *O.M. Scott & Sons Co.*, 467 F.2d 295 (6th Cir. 1972), *petition for cert. filed*, 41 U.S.L.W. 3510 (U.S. Mar. 20, 1973) (No. 72-1127).

It is clear to me from my analysis of the Skeist testimony as above referenced, and the testimony of Dr. Bruins, plaintiff's expert, that the patent sufficiently details the process in suit and does not place an unreasonable burden of experimentation on anyone who wishes to practice the invention.

Moreover, for the same reasons, as set forth under this subheading, I reject defendant's defense of overclaiming. Applicable is the following:

> The inventor is not to be deprived of the fruits of his labor by too technical a requirement of disclosure, and it is adequate for purposes of validity if his claims are sufficiently clear and exact to be understandable by those skilled in the relevant art. *Yosemite Chemical Co.* v. *United States*, 360 F.2d 948, 952 (Ct. of Cl. 1966).

Appendix A

Miscellaneous Defenses

a. *Plaintiff's Alleged Misconduct*

Defendant states:

> Plaintiff misled the Patent Office into granting the patent, and attempted the same tactic in this case, by pretending there was a wrinkling problem *during* extrusion, when delamination only occurred *after* the product was made. Def's Post-Trial Brief, p. 70) [Emphasis in original]

The charge of misconduct fails. *See* Rothman Tr. 168; 173-174.

Moreover, while I have hereinabove used wrinkling as if it were almost synonymous with delamination, the defendant's reference in the above quotation from its Brief suggests that it is appropriate to draw the line carefully between them. As plaintiff has contended, wrinkling can be and is caused by factors during extrusion and is not synonymous with delamination. Indeed, while the latter cannot occur given an adhesive, wrinkling can occur; and wrinkling can occur though there is no separation.

See also, Bruins Tr. 261; 270-272.

Dr. Skeist's testimony on this issue has been reviewed by me and rejected (Skeist Tr. 653; 670; 790).

I find no merit to defendant's charge of wrongdoing by Mr. Fisch or by plaintiff. The patent in suit fairly and correctly states that prior art attempts to extrude metal foil embedded in thermoplastic caused a wrinkling problem "by distortion of the plastic or foil during extrusion or subsequent bending or flexing" (PX-1, lines 24-26).

b. *Defense of Patent Misuse*

Defendant asserts that plaintiff misused the patent in suit by threatening a lacquer foil supplier named Strana-

han with notices of patent infringement. Defendant cites testimony of Mr. Shapiro, a memorandum (DX-KB) and a letter written by plaintiff's counsel (PX-24).

The defense is without merit. A patent owner has a right to notify persons suspected of infringement.

Infringement

Putting aside the question of the VMCH lacquer used by defendant, and the four lacquer films identified in the Claims in suit, there is detailed correspondence and congruence between the accused process, and the process of Claim 1 of the patent in suit. *See* Bruins Tr. 276-280; PX-15B, pp. 55-57; Skeist Tr. pp. 709-712. The issue of infringement thus comes down to whether defendant's VMCH lacquer is sufficiently unlike the Fisch process lacquers as to make for non-infringement.

Plaintiff contends (Proposed Fdg. of Fact 51):

> The essential sameness of VMCH and the "vinyl acetate-vinyl chloride copolymer lacquer" named in the Fisch patent in suit at line 16 of column 2 is demonstrated by the Union Carbide publications (PX 18, PX 21 and PX 23; DX AD).

VMCH, manufactured by Union Carbide, contains 86% vinyl chloride, 13% vinyl acetate, and 1% of maleic acid. Also manufactured by Union Carbide, and closely associated with it in that company's sale of resins, is VYHH, which is made of 87% vinyl chloride and 13% vinyl acetate, which of course is within the Fisch process' "vinyl acetate-vinyl chloride copolymer lacquer" grouping (PX-1, Col. 2). Thus, the only difference between VMCH and VYHH is that VMCH contains 1% maleic acid, with a corresponding 1% diminution in vinyl chloride.

Appendix A

Based upon the Union Carbide description of these products, and the analysis thereof by Dr. Bruins, which I accept, it is clear that the relative performances of VMCH and VYHH are equivalent and that the two products function in the same way to produce substantially the same result, except that "In adhesion to clean steel when it is already dried, VMCH is very good; VYHH is poor." (Bruins Tr. 283). From this plaintiff reasons VMCH is an equivalent to its claimed lacquers.

Defendant's expert, Dr. Skeist, testified that the extra 1% maliec acid in VMCH lacquer made it a terpolymer and hence different from VYHH, but that "the VMCH lacquer adhesively fixed the foil with respect to the extruded thermoplastic" (Skeist Tr. 712), language remarkably similar to that of Claim 1 in suit. The defendant concludes (Def's Post-Trial Brief, pp. 67-68):

> The claims in the suit patent all call for specific adhesives, none of which is used by defendant. One of the claimed adhesives is "polyvinyl acetate—polyvinyl chloride lacquer". However, the defendant obtains from its suppliers an aluminum foil coated with "VMCH", which is not one of the named adhesives, but, instead, is an interpolymerized *terpolymer* made from *maleic acid* and vinyl chloride and vinyl acetate. Thus, to prove infringement, plaintiff must prove that the patent claims are allowed a range of equivalents and are not limited to the claimed adhesives. The difference between the two materials may seem small, only 1% of maleic acid (Bruins, Tr. 281-282), but that small difference here suffices to prove non-infringement. The claims must be given an exact and limited scope without any range of equivalents and cannot encompass even a minor variation. Professor Bruins'

> testimony did not prove that VMCH was the same as polyvinyl acetate-polyvinyl chloride—but only that they were equivalent (Bruins, Tr. 284). [Emphasis in original]

Implicated is the doctrine of equivalents. *Graver Tank & Mfg. Co., Inc.* v. *Linde Air Products Co.*, 339 U.S. 605 (1950), provides:

> In determining whether an accused device or composition infringes a valid patent, resort must be had in the first instance to the words of the claim. If accused matter falls clearly within the claim, infringement is made out and that is the end of it. (339 U.S. at 607).

The doctrine of equivalents is founded upon the realism that, because subtle departures from a patented process or apparatus can be readily devised "to elude the reach of the patent's protection," *Ziegler* v. *Phillips Petroleum Co.*, —— F.2d —— (5th Cir. April 13, 1973), No. 71-2650, patentees must be protected from those minor changes in a patent which leave the patented matter performing the same function in substantially the same way to obtain the same result. *Graver Tank & Mfg. Co., Inc., supra,* provides (339 U.S. at 609):

> . . . [the equivalents doctrine] does not require complete identity for every purpose and in every respect. In determining equivalents, things equal to the same thing may not be equal to each other and, by the same token, things for most purposes different may sometimes be equivalents.

Under the doctrine of equivalents, a patentee of a pioneer patent, for example, one covering a function never

before performed, will be given broad protection. *Corning Glass Works* v. *Anchor Hocking Glass Corp.*, 374 F.2d 473, 476 (3d Cir.), *cert. denied*, 389 U.S. 826 (1967). *See also Hildreth* v. *Mastoras*, 257 U.S. 27, 36 (1921) ("As [plaintiff's] patent is a generic patent, the doctrine of broad equivalents properly applies here"). On the other hand, it follows that a patent on a device which is a mere improvement on prior art will receive a narrower construction under the equivalents doctrine.

The defendant here invokes the doctrine of File Wrapper Estoppel, contending that (Def's Post-Trial Brief, p. 68):

> . . . if an inventor gives up a broader claim in order to obtain a patent having a narrow and specific claim, he cannot later broaden the claim by resort to the doctrine of equivalents, even to encompass a minor variation, *International Latex Corp.* v. *Warner Bros. Co.*, 276 F.2d 557 (2nd Cir., 1960); *Exhibit Supply Co.* v. *Ace Patents Corp.*, 315 U.S. 126, 52 U.S.P.Q. 275 (1942); *Schmidinger* v. *Welsh*, 383 F.2d 455, 155 U.S.P.Q. 289 (3 Cir. 1967).

Factual support is drawn for this position from the File Wrapper (PX-3, pp. 20, 25, 32, 52, 55 and 58), which discloses the four separate rejections of the Fisch application, the amendment four years after filing to specify the four adhesives, including "polyvinyl acetate—polyvinyl chloride" (PX-3, p. 55), and the fact that the stated purpose of the amendment was "to avoid a rejection of too great breadth" (PX-3, p. 58).

Additionally, the defendant argues that the Campbell patent (DX-AD) shows that the addtion of 1% maleic acid to a vinyl chloride—vinyl acetate type adhesive cxeated "a patentably distinct invention." (Def's Post-Trial Brief, p. 683.

Defendant thus concludes its argument on this point by stating that because of the prior art and the Patent Office history, as aforesaid, the plaintiff "cannot expand the patent claims to cover materials, such as defendant's terpolymer VMCH *not* named in those claims." (Def's Post-Trial Brief, p. 68). [Emphasis supplied].

The recent case of *Ziegler* v. *Phillips Petroleum Co., supra*, slip op. pp. 20-21, provides as to File Wrapper estoppel:

> . . . A patentee's consent to the demands of the patent examiner, made to obtain his patent, operates as a "disclaimer," and he is thereafter bound by it. *Schriber-Schroth Co.* v. *Cleveland Trust Co.*, 311 U.S. 211, 221-22 (1940); 4 Deller's Walker on Patents § 234 (2d ed. 1965).
>
> The mere surrender or amendment of a claim in the Patent Office does not, however, forever bar a patentee from asserting the doctrine of equivalents. He is estopped only from reclaiming what he surrendered. *Borg-Warner Corp.* v. *Paragon Gear Works*, 355 F.2d 400 (1st Cir. 1965). Hence it is necessary to determine what in fact the patentee gave up in order to receive its patent, *see Edward Valves, Inc.* v. *Cameron Iron Works, Inc., supra*, and what is the essence of the invention that remains. *U.S. Peg-wood Shank and Leather Board Co.* v. *Sturtevant Co.*, 125 F. 382, 384 (1st Cir. 1903). Moreover, an applicant should not be presumed to have made a disclaimer broader than necessary to yield to the actual challenge to his claim.

Against this background of legal principles I give the patent narrow protection since I do not regard it as a "pioneer" patent. I do not see anything in the history of

the Fisch application to indicate anything, and more specifically, VMCH, was surrendered; and there was of course no cancellation or amendment of a claim calling for VMCH. Finally, I find VMCH to be the equivalent under *Graver* of the "vinyl acetate—vinyl chloride copolymer lacquer" named in the patent in suit. I must and do reject the atatempted distinction by defendant's expert, founded upon the fact that VMCH is a terpolymer containing 1% maleic acid as a third repeating unit, as contrasted with the aforesaid lacquer of the patent which, according to Dr. Skeist, as a copolymer, would have two kinds of repeating units. Aside from the tenuous nature of this distinction, which at best is insubstantial (*See* Pff's Proposed Fdgs. of Fact 54 and Pff's Post-Trial Reply Brief, p. 55), there appears nothing in the record to distinguish the two lacquers in terms of what each accomplishes, and how it accomplishes what it does.

Accordingly, I find Claim 1 of the Fisch patent is infringed by defendant's process.

I make the same findings as to Claims 2 and 3 of the Claims in suit. As to Claim 2, defendant conceded that its foil is "coated on both sides with a VMCH lacquer" (PX-11), and the testimony of Mr. Salcer, defendant's president (PX-12), and Dr. Bruins (Bruins Tr. 288-290), establishes that plaintiff's Claim 3 in suit is infringed by defendant's "Foilastic." *See also*, Rothman Tr. 134-135; 143; PX-5D.

Conclusion

Based upon the foregoing, an appropriate form of judgment, final except for accounting [*see* 28 U.S.C. § 1292 (a)(4)], shall be submitted not later than June 28, 1973, in favor of the plaintiff and against the defendant, covering the relief sought. Trial shall proceed on the damages

issue at the next term of court unless stayed pending appeal. The damages recoverable may include, if the court trying same finds it appropriate, costs such as trial transcript required by me to afford reference to the record on submissions of Proposed Findings of Fact and Conclusions of Law. For guidance only, and expressly stated as not intended to be binding, I record by impression that this case is not an exceptional case within 35 U.S.C. § 285 as to call for attorney fees.

FREDERIC B. LACEY
U.S.D.J.

Dated: June 25, 1973

APPENDIX B

Judgment and Permanent Injunction Order

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF NEW JERSEY

Civil Action No. 1495-69

ANCHOR PLASTICS COMPANY, INC.,

Plaintiff,

v.

DYNEX INDUSTRIAL PLASTICS CORP.,

Defendant.

This cause having come on to be heard upon the pleadings and proofs and having been fully argued by the parties, upon full consideration thereof it is,

ORDERED, ADJUDGED AND DECREED:

1. That the plaintiff Anchor Plastics Company, Inc. is the owner of United States Letters Patent No. 3,136,676 and entitled to the inventions claimed therein and all rights and privileges thereunder.

2. That claims Nos. 1-3, inclusive, of said United States Letters Patent No. 3,136,676 are good and valid in law.

3. That the defendant Dynex Industrial Plastics Corp., a corporation of the State of New Jersey, has since the issuance of said United States Letters Patent, within the judicial district of the United States District Court for the

District of New Jersey and elsewhere, infringed claims Nos. 1-3, inclusive, of said patent by using the processes of such claims to make thermoplastic extruded products having embedded therein metal foil coated on at least one of its sides with a thermoplastic lacquer which extruded products defendant has used and sold.

4. That the defendant Dynex Industrial Plastics Corp., William Z. Salcer, its President, and its other officers, servants, agents, and employees acting on its behalf, and all persons, firms and corporations claiming by, through or under it, be and each and every one of them are hereby permanently enjoined and restrained for the remainder of the term of said patent from infringing, practicing or using or from actively causing or inducing others to infringe, practice or use the processes covered by the claims of United States Letters Patent No. 3,136,676.

5. That the plaintiff have and recover from the defendant Dynex Industrial Plastics Corp. the damages which plaintiff has suffered, adequate to compensate for the infringement which shall be determined pursuant to the provisions of 35 U.S.C. 284 and that trial shall proceed on the issue of the amount of such damages at the next term of this Court.

6. That the plaintiff have and recover its costs and taxable disbursements to date from the defendant Dynex Industrial Plastics Corp.

/s/ FREDERICK B. LACEY
United States District Judge

Dated: June 28, 1973

APPENDIX C

Judgment Order

UNITED STATES COURT OF APPEALS

FOR THE THIRD CIRCUIT

No. 73-1806

ANCHOR PLASTICS COMPANY, INC.

v.

DYNEX INDUSTRIAL PLASTICS CORP.,

Appellant.

(D. C. Civil No. 1495-69)

APPEAL FROM THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF NEW JERSEY

Argued February 14, 1974

Before VAN DUSEN and ADAMS, *Circuit Judges*, and NEALON, *District Judge*

HARVEY E. BUMGARDNER, JR., Esq., ARTHUR, DRY & KALISH, New York City, N. Y.

ELLIOT S. GERBER, Esq. and DOUGLAS W. WYATT, Esq., WYATT, GERBER & SHOUP, New York City, N. Y.

Attorneys for Appellant

Appendix C

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WILLIAM H. HYATT, JR., Esq., PITNEY, HARDIN & KIPP, Newark, New Jersey
Attorneys for Appellee

After consideration of all contentions raised by defendant-appellant, it is

ADJUDGED AND ORDERED that the June 28, 1973, judgment of the district court be and hereby is affirmed. Costs taxed against appellant. See *Anchor Plastics Co., Inc.* v. *Dynex Industrial Plastics Corp.*, 363 F. Supp. 582 (D. N. J. 1973).

By the Court:

VAN DUSEN
Circuit Judge

Attest:

THOMAS (Illegible)
Clerk

Dated: February 22, 1974

APPENDIX D

UNITED STATES COURT OF APPEALS

FOR THE THIRD CIRCUIT

No. 73-1806

ANCHOR PLASTICS COMPANY, INC.

v.

DYNEX INDUSTRIAL PLASTICS CORP.,

Appellant.

SUR PETITION FOR REHEARING

Present:

SEITZ, *Chief Judge*, and VAN DUSEN, ALDISERT, ADAMS, ROSENN, HUNTER, WEIS and GARTH, *Circuit Judges.*

The petition for rehearing filed by Appellant in the above entitled case having been submitted to the judges who participated in the decision of this court and to all the other available circuit judges of the circuit in regular active service, and no judge who concurred in the decision having asked for rehearing, and a majority of the circuit judges of the circuit in regular active service not having voted for rehearing by the court in banc. the petition for rehearing is denied.

By the Court,

VAN DUSEN
Judge

Dated: March 25, 1974.

APPENDIX E

Statutes Involved

(United States Code Title 35—Patents)

SECTION 101. Inventions patentable.

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

SECTION 102. Conditions for patentability; novelty and loss of right to patent.

A person shall be entitled to a patent unless—

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or

(c) he has abandoned the invention, or

(d) the invention was first patented or caused to be patented by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application filed more than twelve months before the filing of the application in the United States, or

(e) the invention was described in a patent granted on an application for patent by another filed in the United

States before the invention thereof by the applicant for patent, or

(f) he did not himself invent the subject matter sought to be patented, or

(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

SECTION 103. Conditions for patentability; non-obvious subject matter.

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

SECTION 112. Specification.

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it it most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Appendix E

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention. A claim may be written in independent or dependent form, and if in dependent form, it shall be construed to include all the limitations of the claim incorporated by reference into the dependent claim.

An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

IN THE

Supreme Court of the United States

October Term, 1973

No. 73-1590

DYNEX INDUSTRIAL PLASTICS CORP.,

Petitioner,

v.

ANCHOR PLASTICS COMPANY, INC.,

Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE THIRD CIRCUIT

SUPPLEMENTAL APPENDIX

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Supplemental Appendix

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APPENDIX G—Soft Copy of United States Patent No. 2,774,811 to A. Shanok et al. 67a

APPENDIX H—Excerpts from "Alcoa Aluminum Foil, Its Properties and Uses" 70a

APPENDIX I—"Coatings and Coating Methods for Aluminum Foil" 92a

APPENDIX J—"Modern Packaging", "Aluminum Foil" 95a

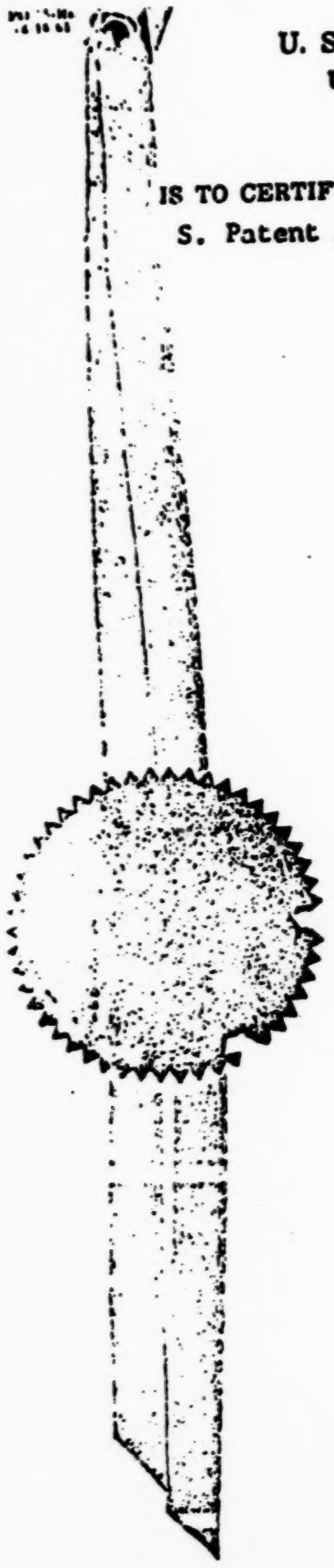
APPENDIX K—"Vinylite Elastomeric Compounds Plastic Bonding" 104a

APPENDIX L—Soft Copy of United States Patent No. 2,685,511 to G. F. Nadeau et al. 121a

U. S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE

September 8, 1971
(Date)

IS TO CERTIFY that the annexed is a true copy from the records of this office
S. Patent 3,136,676.



PLAINTIFF'S EXHIBIT
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By authority of the
COMMISSIONER OF PATENTS

R. C. Sailer

Certifying Officer.

3,xxx,xxx

UNITED STATES PATENT OFFICE.

SEAL OF THE PATENT OFFICE.

Whereas ...ard A. Fisch, of Forest Hills Gardens, ... Wallis Hinkemeyer, and William ... executors of Richard A. Fisch, deceased, ... Products Company, Inc., of Long Island ... a corporation of New York,.

POOR COPY

PRESENTED TO THE COMMISSIONER OF PATENTS A PETITION PRAYING FOR THE GRANT OF LETTERS PATENT FOR AN ALLEGED NEW AND USEFUL INVENTION THE TITLE AND A DESCRIPTION OF WHICH ARE CONTAINED IN THE SPECIFICATION OF WHICH A COPY IS HEREUNTO ANNEXED AND MADE A PART HEREOF, AND COMPLIED WITH THE VARIOUS REQUIREMENTS OF LAW IN SUCH CASES MADE AND PROVIDED, AND

Whereas UPON DUE EXAMINATION MADE THE SAID CLAIMANTS are ADJUDGED TO BE JUSTLY ENTITLED TO A PATENT UNDER THE LAW.

NOW THEREFORE THESE Letters Patent ARE TO GRANT UNTO THE SAID

...al Products Company, Inc., ...s successors OR ASSIGNS

FOR THE TERM OF SEVENTEEN YEARS FROM THE DATE OF THIS GRANT

THE RIGHT TO EXCLUDE OTHERS FROM MAKING, USING OR SELLING THE SAID INVENTION THROUGHOUT THE UNITED STATES.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington this ninth day of June, in the year of our Lord one thousand nine hundred and sixty-four, and of the Independence of the United States of America the one hundred and eighty-eighth.

(SEAL)

...Clarence Wilkes

...Commissioner of Patents

June 9, 1964 R. A. FISCH 3,136,676

METALLIZED PLASTIC EXTRUSION PRODUCTS AND METHOD OF MAKING SAME

Filed Feb. 20, 1957 2 Sheets-Sheet 1

FIG. 1.

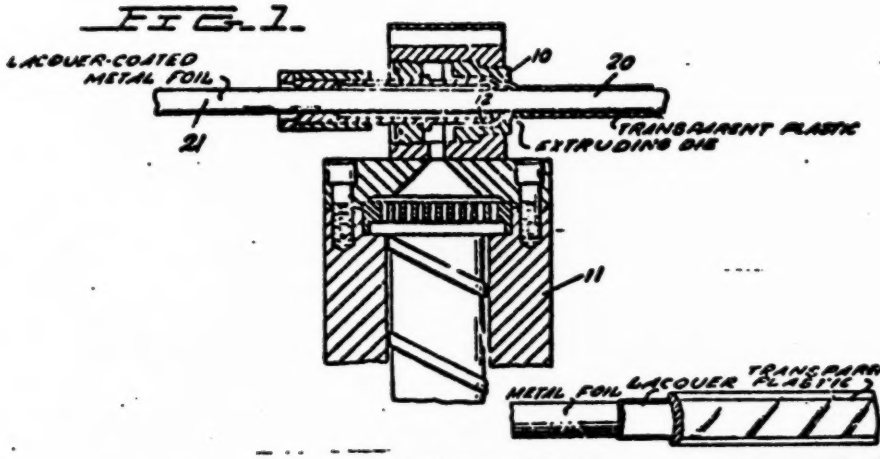

FIG. 1A.

FIG. 2.

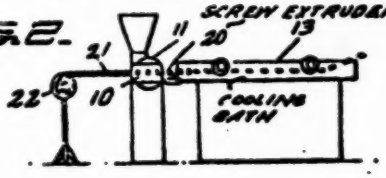

FIG. 3.

FIG. 4.

FIG. 5.

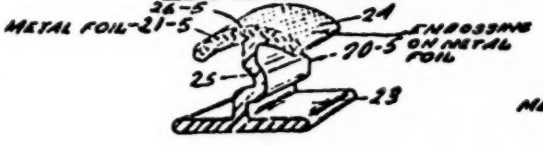

FIG. 6.

FIG. 7.

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Appendix F

June 9, 1964 R. A. FISCH 3,136,676

METALLIZED PLASTIC EXTRUSION PRODUCTS AND METHOD OF MAKING SAME

Filed Feb. 20, 1957 2 Sheets-Sheet 2

FIG. 10.

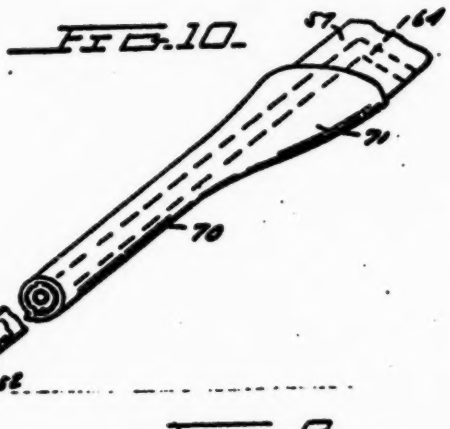


FIG. 8.

FIG. 9.

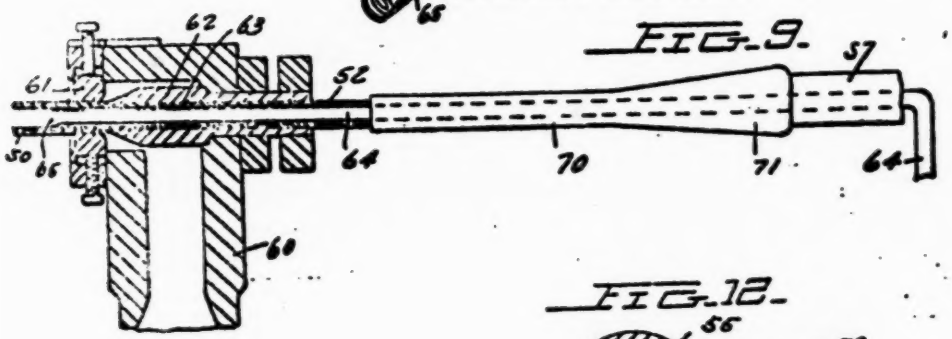


FIG. 12.

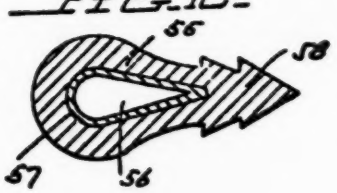


FIG. 11.

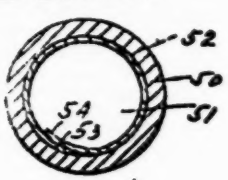
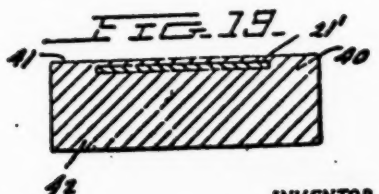


FIG. 19.



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Appendix F

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United States Patent Office

3,136,676

Patented June 9, 1964

1

3,136,676
METALLIZED PLASTIC EXTRUSION PRODUCTS AND METHOD OF MAKING SAME

Richard A. Fisch, Forest Hills Gardens, N.Y.; Hilde Fisch, Willie Schlossinger, and William Guggenheimer, executors of Richard A. Fisch, deceased, assignors to Anchor Plastics Company, Inc., Long Island City, N.Y., a corporation of New York

Filed Feb. 20, 1957, Ser. No. 641,358

5 Claims. (Cl. 156—244)

This invention relates to the production of metallized effects in extruded transparent thermoplastic products.

This application is a continuation-in-part of U.S. application Serial No. 497,948, filed March 30, 1955, now abandoned.

Processes of producing extruded thermoplastic materials with embedded reinforcing wires or strips are well known. Transparent or translucent plastic product which have a light-reflecting, metal-like region due to a thin coating of metal on an inside or outside surface are also known. When it was attempted to obtain a metal-like appearance in a plastic extruded product by embedding a metal foil therein, however, it was found that the inserted foil wrinkled so as to give the effect of an inferior product such as might be caused by distortion of the plastic or foil during extrusion or subsequent bending or flexing or by only loosely associating the foil with the plastic.

Among the objects of this invention is to provide a thermoplastic extrusion product with a light reflecting metallic effect in at least a portion thereof which metallic effect is not removed or injured by scratching or rubbing the surface of the plastic.

Among other objects of the invention is to provide an extrusion product comprising transparent thermoplastic material containing embedded therein, a thin, embossed, highly reflective metallic foil.

Among other objects of the invention is to provide a method of continuously embedding a metallic foil in transparent thermoplastic extrusion products of various cross sectional shapes so as to provide the product with a metallic effect and with an embedded foil which is substantially free from wrinkling and similar defects so that the foil appears as a smooth adherent layer in the interior of the plastic product.

It has heretofore been concluded that metallic foils were too distortable and of too delicate a nature to be embedded in plastics without distortion. Said prior application Serial No. 497,948 is based on the discovery that wrinkling of a thin metallic foil which is embedded in a thermoplastic during extrusion could be prevented by modifying the foil insert so as to permit one side thereof to move with the plastic more freely than the opposite side. It was found that in the ordinary process of extrusion with a delicate foil insert, some parts of the embedded foil adhered more to the thermoplastic layer on the front side thereof whereas other parts of the foil adhered more securely to the thermoplastic layer on the rear side thereof and when shrinkage or fleeting of the plastic occurred, wrinkles due to different tensions were formed in the foil. According to one modification of said prior application, this undesired effect is overcome by embedding a laminated foil having two or more layers so that one layer of the foil can slip with respect to the other layer of foil while the outside surface of the foil adheres to the plastic. According to a second modification the undesirable wrinkling is overcome by applying an adhesive layer to one side of the foil to be embedded.

It has now been found that it is possible to apply a thermoplastic adhesive to one or both sides of the foil to be embedded so that the said one or both sides of the foil are very securely adhered to the plastic material and

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will not wrinkle during or after the extrusion even when the extruded product is severely distorted.

One difficulty connected with securing adhesion between the foil and the plastic is that the foil as it is received contains a very thin layer of oil or lubricant which has been applied during the manufacture thereof. Foils which have been treated to remove the lubricant can be ordered but even such foils contain a residual amount of the lubricant. If the adhesive which is applied to the foil is to be very effective, it must be one which is capable of absorbing or overcoming the non-adhesive effects of the lubricant film. Very satisfactory adhesives which act as adhesives between the foil and plastic in spite of the residual lubricant or oil on the foil are lacquers with a nitrocellulose base. Cellulose butyrate lacquers and vinyl acetate-vinyl chloride copolymer lacquers are also satisfactory.

The extruded product may be of any configuration. Where the products are tubular or hollow, the entire inside of the tubular or hollow portion may be lined with the adherent foil. Thus, even though the metallic portion is only a foil, such tubular products act effectively as electromagnetic shields in electronic devices. Where both sides of the foil are adhesively coated the edges of a foil inside a tube of plastic will be united to produce a fluid-tight metal conduit.

An additional effect is obtained when embossed foils are employed in the process. The foils may be embossed so as to emphasize the light reflecting properties (i.e., so that light is reflected in a multiplicity of directions), and/or to improve the flexibility of the foil. Such products are especially useful as highway markers. The transparent plastic may be colored, red, green, or similar colors so that the light reflected therefrom, is similarly colored. The embossed designs on said foil does not interfere with the extruding process of the invention.

The invention is especially adapted for the production of decorative mouldings, beads and trim strips for cabinets, walls and frames, panel joining strips, decorative designation strips, highway and similar danger markers, etc.

The invention both as to its organization and its method of operation together with additional objects and advantages thereof will best be understood from the following description of specific embodiments thereof when read in connection with the accompanying drawing in which

FIG. 1 is a cross-sectional view of the end of a cross head type of extrusion device as it is applied to the process of the present invention.

FIGURE 1A is a partial sectional view of the article emerging from the process disclosed in FIGURE 1.

FIG. 2 is a front view of an apparatus used to carry out the process of the present invention.

FIGS. 3, 4, 5 and 6 are cross-sectional perspective views of various forms of extrusion products made according to one form of the invention.

FIG. 7 is an enlarged cross sectional view of a portion of an extrusion product made according to the invention.

FIG. 8 is a cross sectional view of another extrusion product made according to the invention.

FIG. 9 is a cross sectional view of an extruding device extruding a tube while lining the same with a metal foil.

FIG. 10 is a detail view, partially broken away, of the means for curving the foil in the extruding device of FIG. 9.

FIG. 11 is a cross sectional view of a product made by the process and apparatus of FIG. 9.

FIG. 12 is a cross sectional view of another product such as made by the process and apparatus of FIG. 9.

FIG. 13 is a cross sectional view of a modified form of product made according to the invention.

A typical cross head type of plastic extrusion apparatus is shown in FIG. 1. In such an apparatus the direction of movement of the extruded product 20 from the extrusion die 10 is at an angle (in this case 90°) to the direction of movement of the plastic material through the screw extrusion device 11.

Such a crosshead extrusion apparatus is advantageous for extruding any type of thermoplastic product containing an embedded material since the material being embedded 21 does not have to pass all the way through the screw extruder 11 and does not have to be bent in order to get to the interior of the extrusion die 10. The die 10 comprises the core 12 through which the embedding material 21 is adapted to pass. This type of extrusion apparatus itself is known and is not a part of the present invention so that details of the apparatus are not described. As an illustration, however, the embedding foil 21 is held in the form of a roll 22 and is continuously fed to the cross head die 10 of the screw extruder 11. After passing through the die, the extruded product 20 is passed through a cooling bath 13.

Depending on the shape of the die, etc., various shapes and effects may be produced by the process as illustrated in FIGS. 3–6. FIG. 3 shows a U-shaped product 20–3 of cellulose acetate containing a layer of foil 21–3 which is coated on the top surface with a layer 26 of cellulose nitrate lacquer which extends beneath substantially all of the outside surface regions of the product.

FIG. 4 shows an angle moulding 20–4 with a layer of foil 21–4 which is coated with a layer 26–4 of cellulose nitrate lacquer, extending beneath substantially the entire surface regions of the product. In these figures the thickness of the layer of cellulose nitrate lacquer is exaggerated for the sake of clarity. In the product this layer may actually disappear and blend in with the cellulose acetate of the main body of the product.

FIG. 5 shows a moulding 20–5 having a rear planar section 23, a front planar section 24 connected by the section 25. In this product only the front section 24 contains the foil 21–5 beneath its surface. The foil 21–5 is coated with a thin layer of adhesive lacquer 26–5 which may have a base of cellulose butyrate, cellulose nitrate, ethyl cellulose, polyvinyl acetate-polyvinyl chloride.

As illustrated in FIGS. 3, 5 and 6 the foil 21–3 may be embossed. An especially useful product is obtained where the foil contains a multiplicity of minute ovate or faceted projections or depressions so as to reflect light in a multiplicity of directions.

In the product 20–6 of FIG. 6 two spaced portions thereof contain the embedded foils 21–6 containing layer 26–6 of plastic adhesive.

In FIG. 7, the product 20–7 contains a single layer of foil 121. On the front surface of the foil 121 is a layer of plastic 122 which is compatible with the plastic 123 of the product. The plastic 122 blends with the hot plastic 123 during the extrusion process and since previously to the extrusion, the foil 121 has been coated with plastic 122 so that a good and uniform adherence is obtained, the foil 121 is effectively united to the product 20–7.

In addition, or in place of the layer 122 of FIG. 7, the lubricating layer 124 of silicone resin may be applied to the rear side of the foil 121.

The width of the foil employed in the process may be from about ⅛ of an inch in FIG. 6, for example, up to six inches or more. In the specification and claims the term laminated foils will be understood to include folded foils as well as coated foils.

FIG. 8 shows in cross section, an extruded strip 20–8 containing the embedded foil 21–8 to the top surface of which (and also, if desired, to the bottom surface) a lacquer adhesive has been applied. The top surface of the plastic body 29 contains a plurality of longitudinal flutes 30, 31 and the spaces 32, 33, 34 flanking the flutes have been partially filled with paint or a pigment material.

The foil employed for such products may be any type of foil but aluminum foil is very satisfactory being easily available and having high reflectivity. The color or appearance of the product may be changed by coloring the transparent plastic material. Thus, a gold bronze or brass appearance may be obtained by coloring the plastic different shades of yellow. An unusual effect is obtained in the product 40 of FIG. 13 wherein the foil 21' is inserted close to one surface 1 of the product. When the plastic of 40 is colored a light yellow the insert 21' as seen from the surface 41 has a silvery appearance whereas the same foil 21' as seen from the surface 42 had a gold appearance.

The bodies 50 and 55 of FIGS. 11 and 12, respectively, have a hollow portion 51 or 56 therein which is lined with a metal foil 52 or 57. Each of these foils is treated on at least the one side which contacts the plastic with an adhesive lacquer solution which is not shown in the drawing. Such products may be made by the process and apparatus illustrated in FIGS. 9 and 10. In this apparatus the plastic material to be extruded is forced through cylinder 60 to die 61 which has an internal core portion 62 for forming the hollow part of the extruded product. A straight opening 63 extends through the core 62 from the die 61 to the side opposite the die 61. The foil tube 52 is fed through this opening 63. Extending through the opening 63 of core 62 is also a tube 64. This tube prevents the foil tube 52 from collapsing and admits air to the interior of the formed tube through the flared opening 65 at the end thereof. The flared end also acts to press the foil tube 52 against the inside surface of the hot extruded plastic tube to assure a union between the thermoplastic adhesive on the surface of the foil and the body of the plastic tube.

The foil tube 52 is automatically formed from a strip of film 57 by passing through the tube forming device 70 having a funnel shaped end 71 adjacent the entrance end of the foil strip 57.

Where both sides of the foil 52 have been coated with an adhesive thermoplastic lacquer, the heat and pressure applied to the foil as it passes between the flared end 65 of the tube 64 and the extruded plastic tube 50 also seals the overlapping edges 53, 54 of the foil.

The hollow strip 55 shown in cross section in FIG. 12 has a notched edge 58 adapted to be forced into a groove to provide a beaded decoration.

The following example further illustrates the process of the invention.

Example 1

A foil which is embossed so as to reflect light at a multiplicity of angles is sprayed on one side with a solution of cellulose nitrate lacquer. The thickness of the layer of cellulose nitrate deposited thereon may be about .001% or less, for example. This foil is fed to an extrusion apparatus such as shown in FIG. 1 with the coated surface facing in such a direction as to be adjacent the front surface of the product to be extruded. A reflective extruded strip without wrinkles or distortions in the embedded foil is obtained. When the plastic is dyed red prior to extrusion a bright red reflection is obtained in the finished product when a light is cast upon the product.

The surface of the foil may be scratched to produce a burnished effect in the finished product. A satin effect may be obtained by brushing or frosting the surface of the plastic. Various combinations of foil treatment and plastic surface treatments may be applied.

The adhesive may be applied to the front surface and to the rear surface of the foil.

The features and principles underlying the invention described above in connection with specific exemplifications will suggest to those skilled in the art many other

5

modifications thereof. It is accordingly desired that the appended claims shall not be limited to any specific feature or details thereof.

I claim:

1. In the process of preparing extruded thermoplastic products with at least one visible region thereof having a metallic appearance, the steps comprising

providing a metal foil having a thin, film-like coating of a transparent thermoplastic lacquer of the group consisting of cellulose nitrate, cellulose butyrate, ethyl cellulose, and polyvinyl acetate-polyvinyl chloride lacquers on at least one surface thereof,

extruding a transparent thermoplastic material about the lacquer-coated foil while feeding the foil in unison with the thermoplastic material with the surface of the foil containing the lacquer coating contacting the interior surface of the extruded material whereby the lacquer-coating of the foil adhesively fixes the position of the latter with respect to the extruded material.

2. The process as set forth in claim 1 in which the metal foil is an embossed foil containing a multiplicity of facets adapted to reflect light in various directions.

3. The process as set forth in claim 1 in which the metal foil comprises a layer of said thermoplastic lacquer on the surfaces of both sides thereof and in which the thermoplastic material is extruded to contact both lacquer-coated sides of said film.

4. In the process of preparing extruded thermoplastic products with at least one visible region thereof having a metallic appearance, the steps comprising

providing a metal foil having a thin, film-like coating of transparent cellulose nitrate lacquer on at least one surface thereof,

extruding a transparent thermoplastic material about the lacquer-coated foil while feeding the foil in unison with the thermoplastic material with the surface of the foil containing the lacquer coating contacting the interior surface of the extruded material whereby the lacquer-coating of the foil adhesively fixes the position of the latter with respect to the extruded material.

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5. In the process of preparing extruded thermoplastic products with at least one visible region thereof having a metallic appearance, the steps comprising

providing a metal foil having a thin, film-like coating of transparent cellulosic lacquer on at least one surface thereof,

extruding a transparent thermoplastic material about the lacquer-coated foil while feeding the foil in unison with the thermoplastic material with the surface of the foil containing the lacquer coating contacting the interior surface of the extruded material whereby the lacquer-coating of the foil adhesively fixes the position of the latter with respect to the extruded material.

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Appendix G

EXHIBIT Q -U.S. PATENT 2,774,811 - A. SHANOK ET AL E1

Dec. 18, 1956 A. SHANOK ET AL 2,774,811

ANTENNA AND TRIM

Filed March 2, 1954

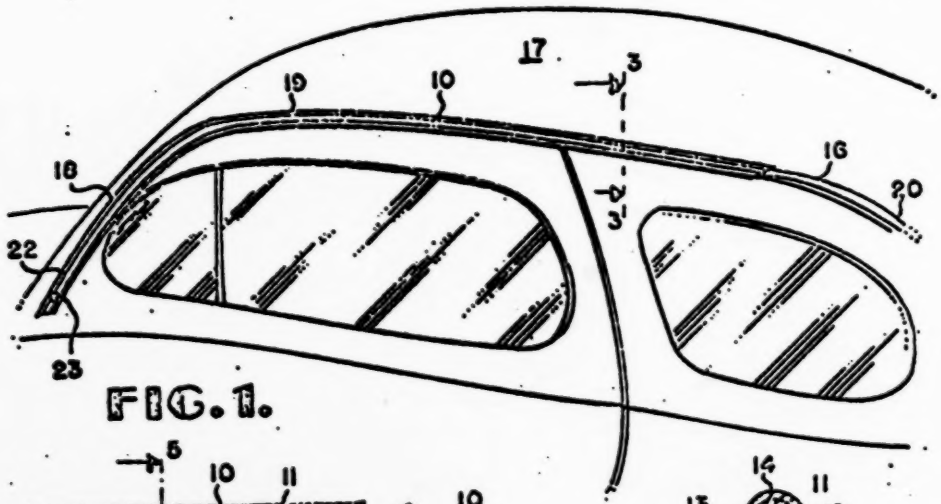

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 5.

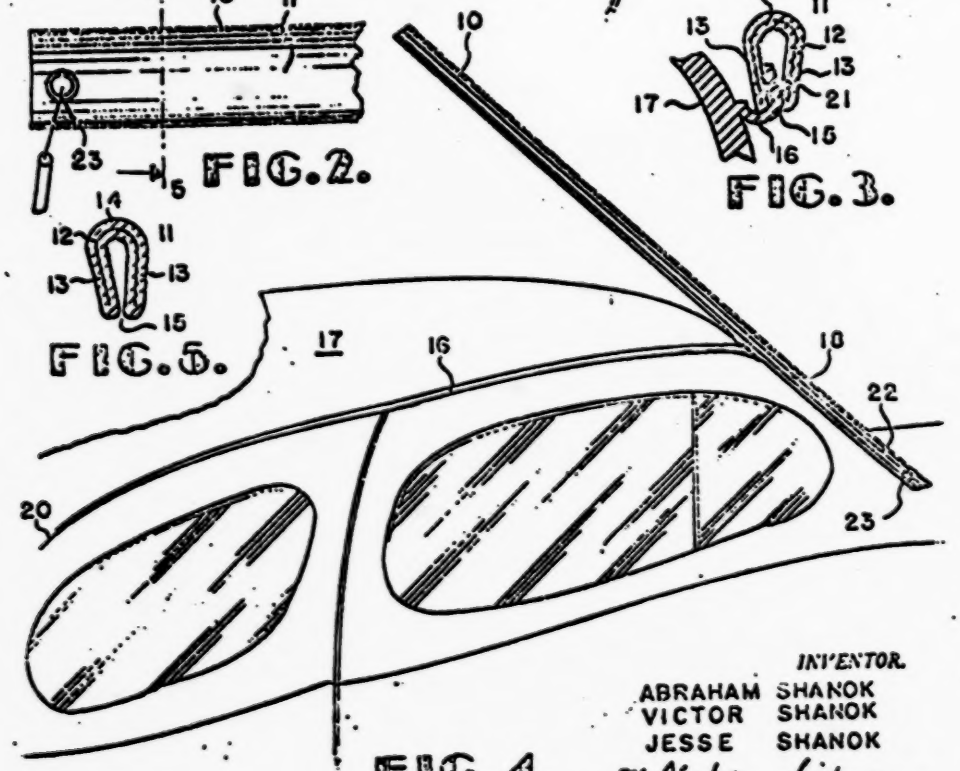

FIG. 4.

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United States Patent Office 2,774,811 Patented Dec. 18, 1956

2,774,811

ANTENNA AND TRIM

Abraham Shanok, Victor Shanok, and Jesse Shanok, Brooklyn, N. Y.

Application March 2, 1954, Serial No. 413,524

2 Claims. (Cl. 174—110)

This invention relates to a radio antenna and decorative trim particularly adapted for use on motor vehicles.

It is one of the objects of this invention to provide an antenna for motor vehicles which is capable of simultaneously functioning as a decorative trim for such vehicles and which may be readily mounted thereon without the use of any special tools and which when so mounted will be maintained in operative position in a firm and secure manner without the use of any special fastening means.

It is a further object of this invention to provide a device of the character indicated which is capable of being applied to a motor vehicle or similar object or any other device having a relatively thin lip, edge or flange and conforming itself to the contours of the ledge or flange to which it is applied and along which it extends.

Another object of this invention is to provide a device of the character indicated which is capable of being readily applied to a motor vehicle along any projecting lip, edge or flange and which when so applied will blend pleasingly with the decorative scheme of the vehicle and add to the aesthetic appearance thereof.

It is also an object of this invention to provide a decorative device of the character indicated which is capable of being formed in strips of substantial length so that any desired length thereof may be readily applied to a motor vehicle.

This invention has for a further object the provision of an antenna in strip form which is capable of being readily mounted upon a metallic object such as the body of a motor vehicle and which is capable of functioning for the purpose of the reception of radio waves in an efficient and effective manner.

It is also an object of this invention to provide a strip of the character indicated which may be readily and efficiently manufactured on a large scale at relatively low cost.

Other and further objects, benefits and advantages of this invention will become apparent from the description thereof contained in the annexed drawings, specifications and claims or will otherwise become obvious. It will be understood that the invention herein disclosed may be employed for other purposes for which the parts, structure and arrangement are adapted.

In the accompanying drawings:

Figure 1 is a perspective view of a portion of a motor vehicle showing the instant invention applied thereto along the rain gutter or drip guard portion thereof,

Figure 2 is a fragmentary side elevational view of a portion of the antenna and trim strip comprising the instant invention,

Figure 3 is a cross-section of Figure 1 taken along line 3—3 thereof,

Figure 4 illustrates the antenna and trim as applied to the forward portion of the rain gutter of a motor vehicle to form a substantially vertically extending antenna, and

Figure 5 is a cross-section of Figure 2 taken along line 5—5 thereof.

As shown in the accompanying drawings, particularly Figures 2, 3 and 5, the device is comprised of an elongated channel strip designated generally by the numeral 10. Strip 10 is of substantially U-shaped cross-section. The strip is formed of a synthetic resin or plastic material which is relatively rigid but capable of being flexed sufficiently to conform to the contours of an object to which it is applied and along which it extends as will more clearly appear hereafter.

Encased within the plastic or synthetic resin material forming the body 11 of the strip and completely enveloped thereby is a tape or ribbon of conductive material such as metal foil 12. It is preferred to form strip 10 by extending the plastic insulating material over the tape or ribbon of metal foil 12. The foil is thereby encapsulated within the plastic insulating body 11. In practice it has been found advantageous to utilize a transparent plastic material which is extruded over a ribbon of aluminum foil to thereby form a continuous strip which closely resembles the chrome or stainless steel stripping or decorative trim material which is customarily applied to the body of a motor vehicle. A suitable plastic material for this purpose is cellulose acetate butyrate although it will be understood that other similarly suitable plastic materials may be employed for this purpose.

Said channel strip being substantially U-shaped is thus comprised of a pair of opposed arms or sides 13 and a closed end or bight portion 14 connecting said sides. The end or bight portion 14 which connects the sides of said U-shaped body is substantially semi-circular in cross-section and said sides 13 converge toward each other along their free ends. The free ends of the side portions of the channel body are positioned close together and in substantial contiguity along the length of the channel strip body thereby forming a very restricted longitudinally extending opening therefor as shown at 15.

The strip may be mounted along any comparatively thin projection such as a rim, ledge or flange which is customarily formed on various portions of an automobile body. Thus for example it may be applied along the lip or free edge of the drip guard or rain gutter usually surrounding the door frame openings and extending along the top of a vehicle; the marginal lip or rim of the doors thereof or the flange or rim usually surrounding the cover of the trunk compartment. The strip 10 is applied along any such thin projection by inserting said lip or projection into the longitudinally extending opening 15 between the free ends of the side arms 13. The open portion of the strip body is applied against the projection and the channel strip is then pressed thereon along the length of the projection. The pressure thus applied spreads the free ends of the side arms and thus permit the projection to enter the channel portion of the strip. The side arms 13 are thus sprung apart a sufficient distance to receive the projection; the plastic material being sufficiently resilient for this purpose. The strip may be readily pressed onto the projection progressively along the length thereof. When the strip has thus been mounted upon a lip or projection of this character the resilience of the arms causes them to tend to return to their normal initial position and bear against said projecting body or lip to thus firmly mount and maintain the strip in position thereon. As has been heretofore indicated, the strip is capable of being bent or flexed along its longitudinal axis so that it may be mounted along a projection having a longitudinal curvature formed therein and when so mounted will conform to such curvature thereof.

It should be noted that the metallic strip is entirely enveloped by the insulating plastic material and is thus spaced and insulated from the metallic body of the projection. Furthermore, in view of the tapered cross-section of the strip due to the converging relation of the arms 13,

the projection or lip upon which the strip is mounted is gripped principally in the region of the free ends of the arms, the upper portions of said arms as well as the semi-circular end or bight portion being spaced substantially from the metal lip projection. Thus the foil is spaced from the metal body of the vehicle by the interposition of the plastic dielectric material of the strip along the side edges thereof, the main body of the foil being spaced therefrom much more substantially and with the added interposition of the dielectric effect of the air therebetween. As a result of this arrangement the capacity effect which may exist between the conductive ribbon foil and the metallic body of the vehicle is substantially reduced thereby materially increasing the efficiency of the antenna strip in the interception of radio waves. Connection of the antenna to the conventional lead-in cable leading to the antenna input terminal of the radio receiver is readily accomplished by means of an electro-conductive metallic connector such as a rivet 23 attached to the foil through an opening 16 in the insulating material, said rivet being electrically connected to the antenna lead-in cable.

The manner in which the antenna and trim strip 10 is applied to the drip guard or rain gutter 16 of a motor vehicle is more particularly illustrated in Figures 1 and 3. The drip guard 16 is comprised of an open channel secured to the body 17 of the motor vehicle and usually extends substantially vertically forward of the upper portion of the car door frame as shown at 18, thence along the top of the vehicle along the door frames as shown at 19 and around the upper portion of the rear door frame as shown at 20. Strip 10 is mounted upon the drip guard 16 by forcing the lip 21 of the drip guard between the opening 15 of the free ends of the sides 13 of the strip. The sides 13 of the strip are thus forced or sprung apart and the lip 21 is resiliently gripped between the end portions of said side arms.

One end 22 of strip 10 is provided with a suitable lead-in cable connector as shown at 23. The strip is advantageously applied by pressing it upon the lip 21 of the drip guard 16 beginning with end 22 and then progressively pressing the remainder of the strip along said guard. In this manner the lip will progressively enter the opening 15 extending longitudinally of strip 10. As the strip is applied it automatically flexes longitudinally to accommodate itself to the curvature of the bend formed as the substantially vertical forward portion 18 of the guard merges with portion 19 of the guard extending horizontally along the top of the vehicle. The antenna may be applied in any length desired. In view of the transparency of the plastic the visible aluminum foil presents an appearance which blends pleasingly with the general chrome and metal trim on the vehicle and is completely unobtrusive. When applied to this particular portion of the car it presents no unsightly projection and is substantially unrecognizable and indistinguishable. If desired, a similar strip may be applied along the other side of the automobile and said antenna strips may be independently connected to radio apparatus within the car or they may be interconnected for the purpose of improving reception in a manner well known to those skilled in the art. Said additional strip may also be left unconnected and thus utilized to produce a balanced decorative appearance for the motor vehicle. Thus the strip may be utilized as a decorative element substantially enhancing the appearance of the car.

Figure 4 illustrates another manner in which the strip may be applied to a motor vehicle body to serve the purpose of a substantially vertical antenna. In this form of application of the invention the strip 10 is mounted along

the forward portion 18 of the gutter or drip guard 16 only. The strip is used in sufficient length to extend upwardly beyond the top of the automobile to the extent desired. The resilient grip of the sides 13 of the strip against the portion of the lip 21 of the gutter along which it extends is sufficient to support the freely extending portion of the antenna. The antenna is connected to the lead-in cable of the car radio by means of a connecting element as shown at 23 in the manner heretofore described. It will be understood that the antenna and decorative trim comprising the present invention may be mounted upon or applied to other portions of a motor vehicle having a suitable projecting portion or to other structures or devices upon which it is adapted to be mounted by reason of the arrangement thereof.

We have here shown and described a preferred embodiment of our invention. It will be apparent, however, that this invention is not limited to this embodiment, and that many changes, additions and modifications can be made in connection therewith without departing from the spirit and scope of the invention as herein disclosed and hereafter claimed.

Having disclosed our invention, what we claim as new and desire to secure by Letters Patent is:

1. A radio antenna for a motor vehicle including a relatively thin projecting lip member comprising an elongated channel-shaped body portion of substantially U-shaped cross-section, said body portion including opposed sides and an enclosed end and being formed of an electrically insulating synthetic resin, a metal foil ribbon extending longitudinally through said strip and enveloped thereby, said enclosed end being substantially semi-circular in cross-section, said opposed sides converging toward each other along their free ends, said free ends being positioned in substantial contiguity to form a longitudinally extending opening for said body whereby said projecting lip is adapted to be received between said opposed sides and to be resiliently gripped therebetween and means for electrically connecting said metal foil to the input terminal of radio equipment within said vehicle.

2. A radio antenna for a motor vehicle including a relatively thin projecting lip member comprising an elongated channel-shaped body portion of substantially U-shaped cross-section, said body portion including opposed sides and an enclosed end and being formed of an electrically insulating synthetic resin, a metal foil ribbon extending longitudinally through said strip and enveloped thereby, said enclosed end being substantially semi-circular in cross-section, said opposed sides converging toward each other along their free ends, said free ends being positioned in substantial contiguity to form a longitudinally extending opening for said body whereby said projecting lip is adapted to be received between said opposed sides and to be resiliently gripped therebetween, said semi-circular end portion being spaced from said projecting lip and means for electrically connecting said metal foil to the input terminal of radio equipment within said vehicle.

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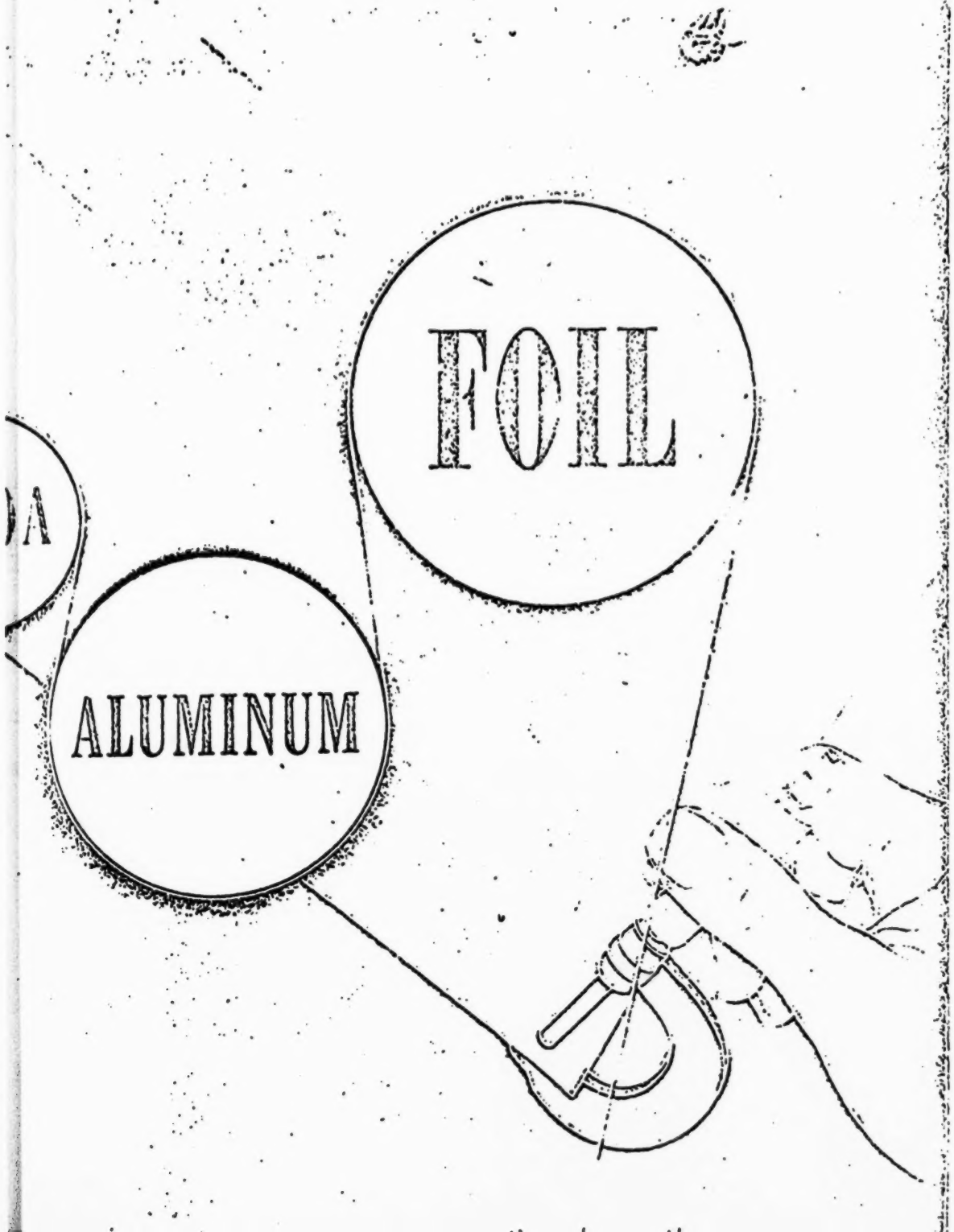
EXHIBIT X - EXCERPTS -"ALCOA ALUMINUM FOIL" - 1953 E4



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LCOA

LUMINUM

)IL

e properties

nd uses

ALUMINUM COMPANY OF AMERICA was the first commercial producer of aluminum foil in the United States. Today, as a result of Alcoa's early pioneering before World War I, aluminum foil is the most available, most economical and most commonly used metal foil. The spectacular increase in the use of aluminum foil parallels the rapid expansion of the aluminum industry, which is supplying this versatile, lightweight metal for thousands of old and new uses in numerous fields of application. This booklet contains general technical information about Alcoa aluminum foil which will aid those responsible for the selection and use of the proper material.

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holes seem to be an inevitable result of rolling tal to very thin gages. The best rolling practices d equipment seem able only to control the size d number.

From measurements under the microscope, the al area of all the pinholes in 100 square inches of 04 inch foil was estimated to be about 0.00004 uare inch. This value is almost insignificant. It is imated that a single hole of this area would rmit water vapor transfer at a rate of about .19 ams per twenty-four hours per 100 square inches th air at 100 per cent relative humidity and 0° F.

Table 3

TYPICAL VARIATION OF PINHOLES WITH GAGE

100 sheets of foil, 12" square, were examined for each gage.

Gage of foil in inches	Number of sheets with pinholes	Number of sheets with no pinholes
0.00035	100	None
0.0005	100	None
0.0007	15	85
0.001	8	92

The permeability or protective characteristics of different specimens of foils may be illustrated by their resistance to water vapor transmission. See Table 4.

WATER VAPOR TRANSFER

An indication of the effect of pinholes upon water vapor transfer is given by data in Tables 3 and 4, which present characteristic water vapor transfer values for foil of four different gages commercially used in packaging. In making this test, 100 sheets (12 inches square) of each gage of foil were taken and every tenth sheet tested for water vapor transfer. In the case of .001 inch foil, however, only eight of the one hundred sheets showed pinholes in the test and in the case of .0007 inch foil, only fifteen of the one hundred sheets showed pinholes. In the heavier gages, only

Table 4

WATER VAPOR TRANSMISSION OF THIN ALUMINUM FOILS*

Thickness of foil in inches	W.V.T. (gram water per 100 sq in. per 24 hours with air at 100°F and 100% R.H.
0.00035	0.62
	0.11
	0.20
	0.23
	0.15
	0.69
	0.29
	0.34
	0.18
	0.07
Average	0.29
0.0005	0.08
	0.05
	0.06
	0.12
	0.15
	0.09
	0.13
	0.31
	0.17
	0.04
Average	0.12
0.0007	0.07†
	0.08
	0.06
	0.05
	0.04
	0.08
	0.01
	0.04
0.001	0.02†
	0.03
	0.02

*Water vapor transmission determined by General Foods' Southwick method. Every tenth sheet of the 100 specimens of each gage inspected for pinholes (Table 3) was selected for water vapor transmission tests.

†Water vapor transmission values not averaged because majority of 100 sheets examined had zero permeability.

foil converting operations

The inherent functional and decorative characteristics of aluminum foil can be utilized and enhanced by converting operations to meet hundreds of applications. Conversion of aluminum foil comprises the following general operations:

1. Lacquering or coating
2. Laminating
3. Printing
4. Embossing
5. Shearing

Details of equipment for the various foil converting operations vary from one type unit to another and are outside the scope of this booklet. However, some desirable and necessary features will be given that are generally applicable in one form or another to the equipment used in converting foil.

TENSION CONTROL

In converting operations, special attention should be given to the proper handling of the foil. Controlled tension is essential to smooth unwinding and rewinding of the coiled stock. It assists in maintaining an unwound section of foil flat and free from wrinkles during converting operations. Adequate power facilities for braking and driving the machine are essential in providing a satisfactory tension. A constant tension, regardless of coil diameter, controlled to function automatically with uniform acceleration or instant deceleration of the drive, is desirable at all times and essential to high speed operations. Applied tension should not exceed the yield strength of the web, and a safe tension value is normally about one-half of the ultimate tensile strength. In the case of annealed foil, this is three pounds per inch of width per mil of thickness. For hard metal it is seven or eight pounds per inch of width per mil of thickness. To avoid breaking or strain hardening, annealed foils should not be subjected to any greater tension than is necessary to promote and maintain a smooth web.

SUPPORT AND IDLER ROLLS

Handling equipment should be so designed as to minimize all distances over which the foil is unsupported. This can be accomplished by the use of supports of well-balanced idler rolls having good bearings and smooth surfaces. Proper arrangement of guide rolls to alter the direction of travel for the foil web or to form compression contacts (nip rolls) assists in maintaining flatness and tension. Proper arrangement is particularly advantageous in preparing the foil web for contact with coating roll.

A good device for supporting the foil and removing wrinkles and fullness in the metal is a spreader or herringbone roll, as illustrated in Fig. 2. The herringbone roll is a helically grooved roll, which may be from 4 inches to 12 inches in diameter. Foil is threaded over the herringbone roll with a wrap of 30 per cent, depending on the gage and condition of the foil, so that the metal spreads outward to prevent the formation of wrinkles and creases.

Several types of conveyors may be used satisfactorily in drying ovens of finishing machines to support the foil web between the application unit and the rewind stand. Slat type conveyors or rod type conveyors, as well as idler rolls placed 12 inches to 18 inches apart, are frequently used.

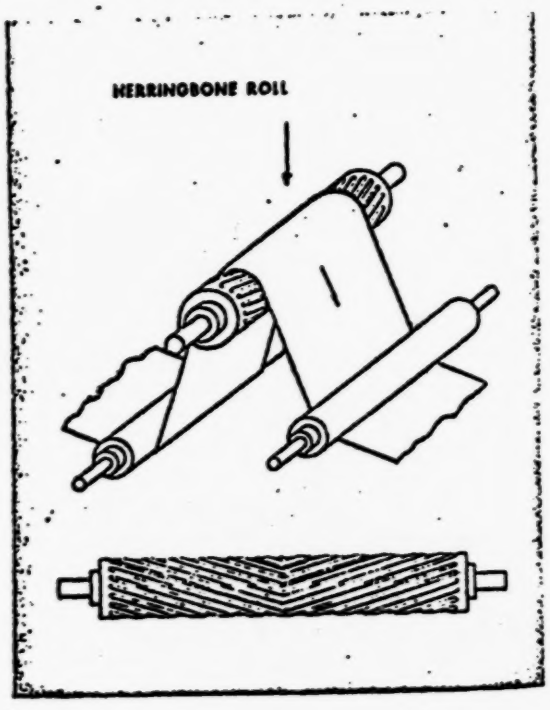
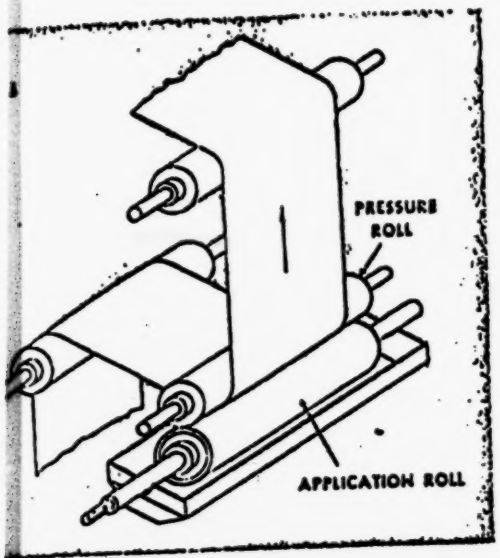


Figure 2. **HERRINGBONE IDLER ROLL**
Passing the material web over a herringbone idler roll will assist in reducing the apparent wrinkles coming from an irregular web.

application methods



...3. SQUEEGEE APPLICATION UNIT

...pplying unit, the bottom or application roll of soft rubber ...ially submerged in the coating medium. Rotating with the ...at a speed slightly less than the web velocity, the application ...ries the coating on to the web at the contact point between ...plication roll and top pressure roll.

...metal pressure roll is adjustable in relation to the applica... roll. By varying the pressure, squeegee action will regulate ...mount of coating applied to the web.

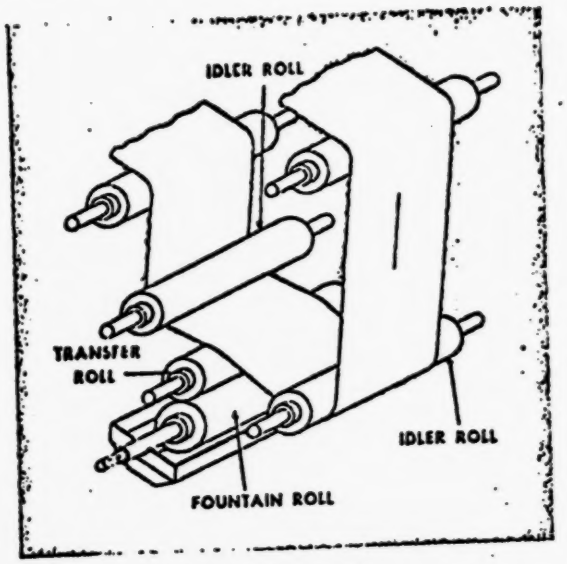
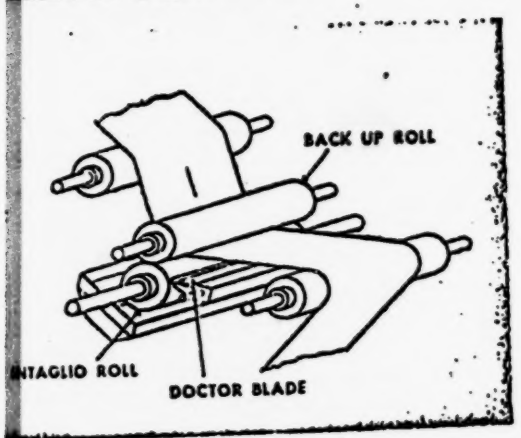


Figure 4. TRANSFER APPLICATION UNIT

In this coating unit the bottom or fountain roll, preferably of soft rubber, runs partially submerged in the coating medium. Here it carries the coating to the top transfer roll.

Material being coated passes over the transfer roll with a slight contact arc which is important in controlling coating. To vary the contact arc one or both idler rolls are adjusted vertically.



...e 5. INTAGLIO APPLICATION UNIT

...pplying coatings by means of the intaglio roll, an engraved ...per roll about 6 inches in diameter is partially submerged in ...coating medium and rotates with the web at the same velocity. ...A full face laminated doctor blade wipes the excess coating ...m the intaglio engraved surface.

...he web follows the contour of the top hard rubber back-up ..., permitting an approximate line contact of the web and ...glio roll.

...hrome plating the intaglio roll after engraving adds con...rably to the life of the engraved roll.

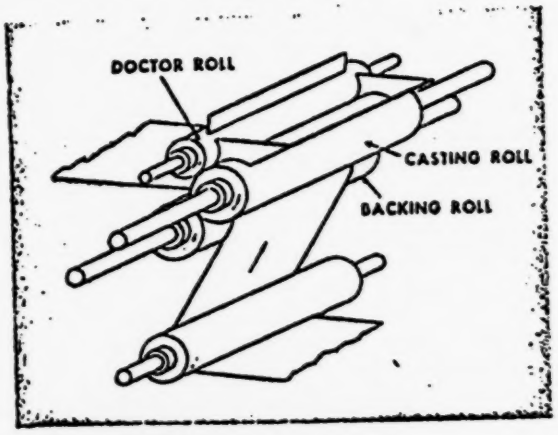


Figure 6. REVERSE ROLL COATER (Patented)

The reverse roll coating method is principally a three-roll coating unit. A backing roll rotates with the web at the same relative velocity, while a center casting roll rotates in the opposite direction to the web, casting the coating medium on the web. Here the backing roll is adjustable in relation to the casting roll.

The doctor roll, a third roll adjustable in relation to the casting roll, meters the amount of coating coming from the fountain.

APPLICATOR SYSTEMS FOR LACQUERS, ADHESIVES AND LIQUID INKS

No single method of application or type of equipment for lacquering, printing or laminating foil is commercially feasible, because choice may be dictated by conditions of foil gage, coating materials, ultimate use requirements or economy. The common methods of lacquer and adhesive application are squeegee, transfer, intaglio or engraved rolls, and reverse roll coaters. These methods are illustrated in Figs. 3, 4, 5, and 6. Lightweight coatings are usually applied by the squeegee; transfer intaglio rolls and the more versatile reverse roll coaters are the preferred equipment for heavier coatings.

DRYING EQUIPMENT FOR SOLVENT REMOVAL

Equipment for solvent removal in printing, lacquering or laminating aluminum foil may be identical in design to that used for other flexible sheets. The common and conventional type of drying is forced air convection. The heat source may be gas, steam or electricity. Important factors to be considered are the impervious, nonsorptive surface of aluminum foil, its high thermal conductivity and high reflectivity for radiant heat.

In practically all of these operations, large amounts of volatile solvents must be cared for and ample ventilation facilities should be provided for their removal. It is only safe to consider them as potential health and fire hazards. Solvents likely to be employed include alcohols, hydrocarbons, ketones, and esters of the more volatile type.

Effective means for solvent removal are: counterflow air currents, or alternate blowing and removal (by suction) of hot, dry air. Radiant heat may also be used for drying if it impinges on a surface that will absorb the heat efficiently. Since aluminum foil has a high reflectivity value (95 per cent), radiant heat should be applied to the paper or plastic side in the case of laminated sheets or on a surface to which a substantial film of ink or lacquer has been applied.

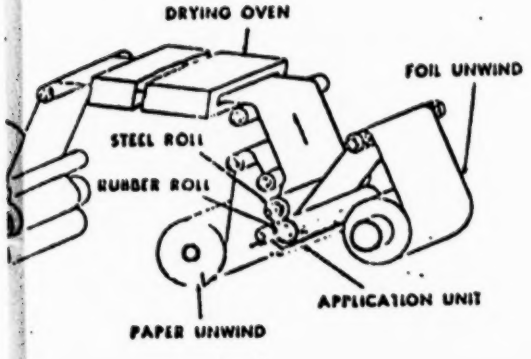
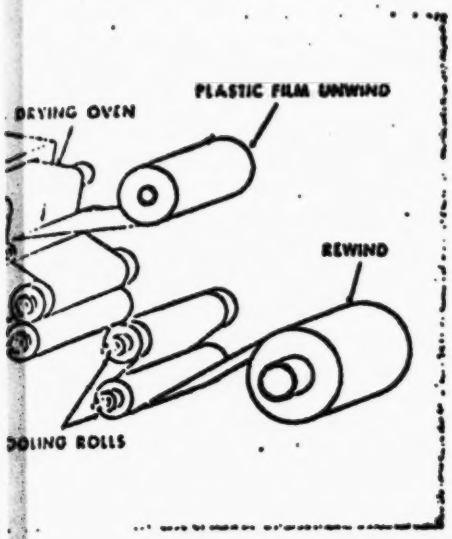


Figure 7. **COMBINING UNIT FOR FOIL AND PAPER**
In combining foil and paper, the adhesive is applied to the foil through a modified squeegee unit. A rubber transfer roll is partially submerged in the adhesive and rotates at a speed less than the relative velocity of the web. This roll runs continuously so that even when the machine is stopped the adhesive will not dry on the unsubmerged surface.

LACQUERING OR COATING, AND LAMINATING

Lacquers and other coatings are usually used for decoration, protection or to produce a heat-sealable surface and may be applied as a continuous film over one or both surfaces of the foil. Both lacquers and adhesives, which are used in laminating foil to various supporting sheets, may be applied by any one of the methods described previously. In laminating foil to paper with water soluble or dispersed adhesives, the adhesive is preferably applied to the foil by one of the methods described and the foil brought in contact with the paper web immediately after leaving the application unit, as illustrated in Fig. 7. In mounting foil to various transparent sheets and other nonporous surfaces, however, the adhesive is applied to the surface of the foil in the same manner, but the coated foil is passed through a drying tunnel to remove the solvents before the bond is effected by bringing the foil in contact with the supporting sheets between heated pressure rolls. This is illustrated in Fig. 8. In the case of both lacquered and laminated foils, cooling rolls, placed immediately ahead of the rewind unit, are used advantageously to lower the temperature of the heated web and thus prevent blocking or sticking.

In handling hot melt adhesives, a somewhat different procedure is used. The adhesive material in this case is generally applied to the surface of



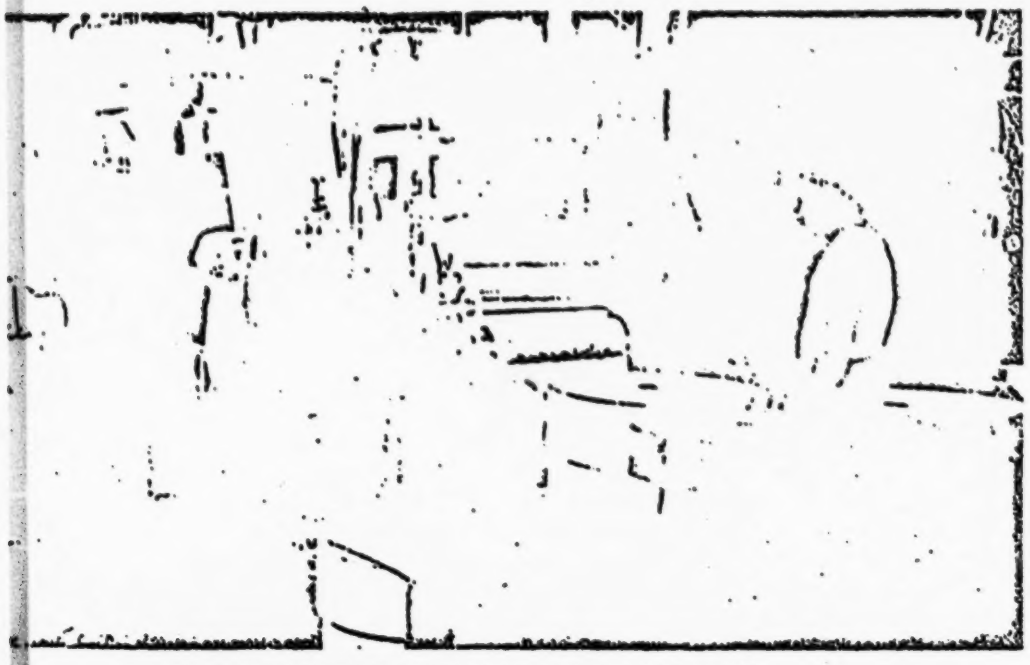
COMBINING UNIT FOR FOIL AND PLASTIC FILMS
The foil web coming from the solvent evaporating compartment combines with the plastic film and this composite is pressure set through the hard rubber and steel pressure rolls. The steel roll is heated electrically or with steam and is driven at the velocity of the composite web.
After leaving the pressure roll unit, the heated web is cooled as it passes over the double-roll cooling unit.

the supporting sheet and, after chilling, is brought in contact with the foil and bonded with the aid of heated pressure rolls. The laminated material is subsequently cooled and rewound.

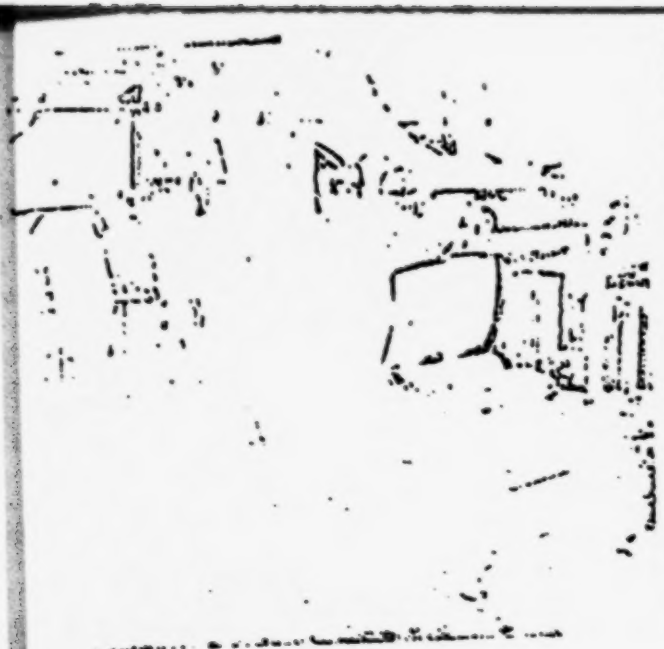
PRINTING

Aluminum foil can be printed satisfactorily by any of the accepted commercial processes which are based on the three fundamental types of printing—typographic, planographic and intaglio. Variations of these basic procedures are known in the trade as letterpress, aniline, Anilox, lithographic, silk screen, offset, gravure and rotogravure. The most commonly used and accepted methods for printing on foil are termed aniline and rotogravure.

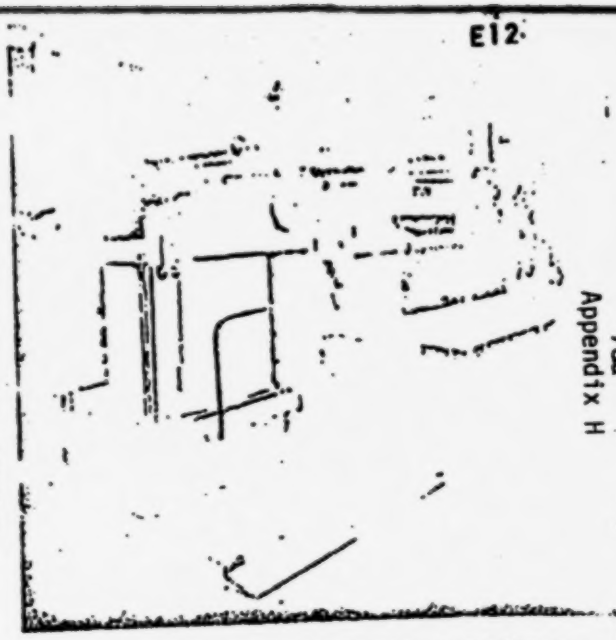
Aniline ink printing is versatile and is used in the printing of both supported and unsupported plain foils. Thin foils should be supported by paper or other cushioning sheets. This method of printing is particularly applicable for producing decorative wrappers of all kinds from coiled foil alone or foil combined with other flexible packaging materials. The drying speed of aniline inks and the ease and low cost of preparing rubber plates



This machine laminates aluminum foil to paper and slits it into multiple cuts in one operation.



A four-color aniline press shown above represents one of the types commonly used in the printing of aluminum foil and other flexible packaging materials.



Aluminum foil backed with a supporting sheet is ideally suited to gravure printing. Presses equipped with a sheeter, such as the one above, are capable of excellent performance at high speeds.

place this method in an advantageous position to handle smaller production items. Aniline ink printing is restricted in the application of its designs to foil only by limitations of the rubber plates for reproducing fine lines and halftones and by the characteristics of the ink films to meet severe requirements.

Rotogravure printing is recognized for its quality in subject duplication, color, uniformity and the wider range in tonal effects from strong, deep colors to the extremes for highlighting. It also offers operating advantages in high speed production and long production runs. Web printing by rotogravure is an economical process for the volume production of foil-paper backed labels and overwraps.

SURFACE PREPARATION FOR PRINTING

Prime or wash coatings are commonly used on laminated foils that are subsequently printed. This treatment is frequently given where adherence and durable life of the printing are stressed. Priming with a wash coat may be done in conjunction with the laminating operation or may be applied in the initial color stand of a multicolor printing press. These solutions are dilute and fast drying.

Phosphoric acid in alcohol can be used to improve the wetting characteristics of foil if the [illegible] sheet does not have to withstand water. Plasticized shellac or shellac plus a small quantity of phosphoric acid in alcohol may be used for such applications. Where water resistance is important, vinyl resins such as polyvinyl butyral may be used to advantage in formulating wash coatings.

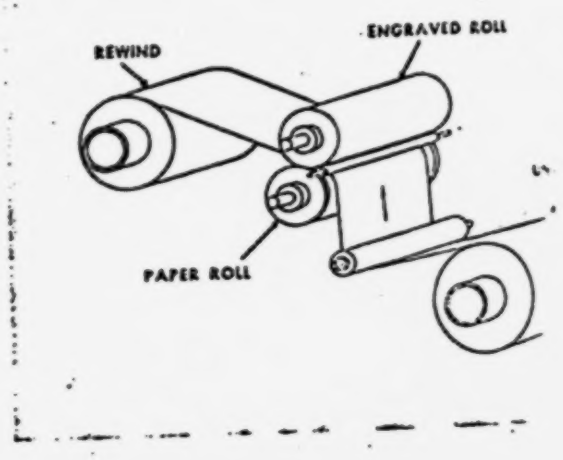


Figure 9. EMBOSSING UNIT

An engraved steel roll, usually the top roll, carries the design, and a matching paper roll becomes the matrix.

This matrix roll is constructed of layers of paper (wool rag paper) rings compressed solidly into one continuous mass with steel end rings holding it intact.

The web follows the contour of the matrix roll through the contact point of the roll set where pressure is applied between the rolls.

OSSING

e embossing of aluminum foil is normally
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by passing the web through a roll stand
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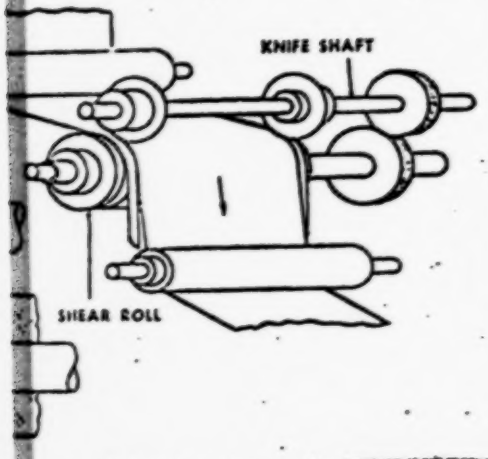
in a fixed position and using only the weight
steel roll to depress the negative pattern into
per roll. Screw or hydraulic pressures may be
d to embossing operations when necessary
rable. This is the procedure commonly used
mbossing aluminum foils or laminated foil
inations and is illustrated in Fig. 9.
inated foil combinations or heavier gage
ay also be embossed on equipment consisting
engraved steel rolls. The design is engraved
e steel roll (male) and the negative to this
on a second steel supporting roll (female).

It is essential that these steel rolls be designed and mechanically equipped to register exactly for the embossing operation. Also, the engraving and operation of the embosser must be precisely executed to avoid cutting the material or marring the engraved rolls.

SHEARING

Shearing or slitting operations are a necessary part of practically all foil converting operations. Shearing is required to produce narrow coiled widths, to trim the edges of coated or laminated stock and to produce rectangular pieces. Die cut designs by rotary or stationary die settings and shearing with flying knife cutoffs may also be included as shearing methods.

Guillotine shears are standard equipment for square shearing. Plain foil is usually interleaved with thin paper (10 lb to 15 lb tissue) before square shearing. This is done to facilitate separation of the thin foil sheets by eliminating interlocking or sticking edges, to add support and rigidity to the stacked sheets and to minimize surface marring



10. IDLER ROLL SHEAR UNIT
FOR COATED AND LAMINATED FOIL PRODUCTS

Shear unit the foil web follows the contour of the bottom roll sufficiently to rotate the unit and thus drive the top knife shaft. Gears mounted at one end of the unit a speed increaser, thereby permitting the top slitting to operate at a greater velocity than the web (approxi- 20 per cent).
bottom shear roll is assembled with heat-treated steel clamped between mild steel spacers, and the assembled ound as a unit.

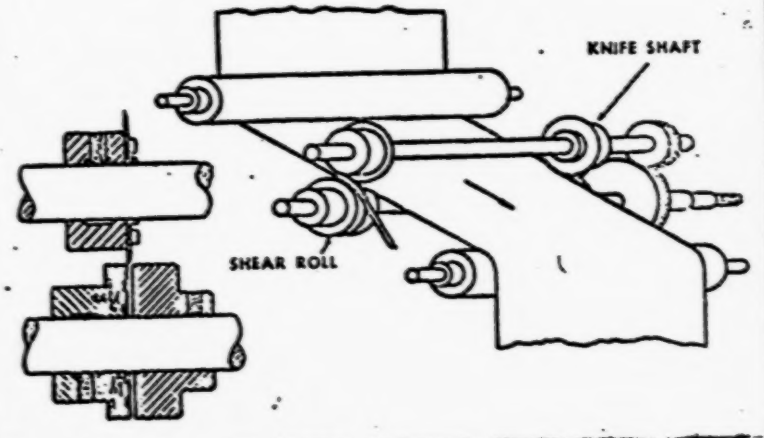


Figure 11. DIRECT SHEAR UNIT FOR COATED AND LAMINATED FOIL PRODUCTS

Material sheared by the direct shear method must be supported on both sides of the shear unit to maintain flatness of web.

The shear unit is externally driven with the bottom knives rotating with the same velocity as the web. Gears located at one end of the unit represent a speed increaser, allowing the top slitting knives to operate at a greater velocity than the web (approximately 20 per cent).

from handling and shipping. Foil in the hard condition and annealed foil when lacquered, mounted on paper or other supporting sheets, do not usually require interleaving for square shearing.

The most commonly used method of slitting or shearing laminated coiled material is the shear cut. This method of shearing is illustrated in Figs. 10 and 11. Shearing equipment must be sturdy and true to prevent weaving and avoid physical defects in the wound, slit coils. Shear knives must be properly set, firmly fixed, sharp and otherwise in good condition. Knife edges are preferably lubricated with a volatile, nonstaining material such as very lightweight white oils or kerosene.

lacquers, adhesives and inks used with aluminum foil

Many types of lacquers, adhesives and inks are used in foil converting operations, and some general information on the desirable characteristics of these materials will be given.

LACQUERS AND COATINGS

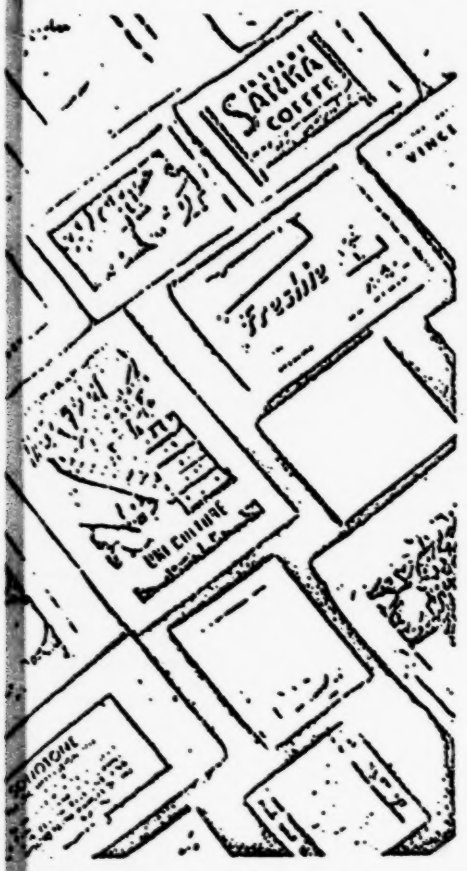
Lacquers and coatings used on aluminum foil may be classified as decorative, heat sealing and protective. Basically, each type should be characterized by good adherence and film forming characteristics. Since many of these materials may come in contact with food products, it is essential that they be nontoxic and free from any residual odor or taste.

DECORATIVE LACQUERS

Decorative lacquer formulations are expected to include resins, plasticizers and nitrocellulose. They include solvents properly blended to give a viscosity flowout and evaporation rate appropriate to the method of application and required film characteristics. Resins, both natural and synthetic, blended and plasticized are also used to produce decorative finishes. Decorative foil lacquers may be colored with dissolved dyes, dispersed lake colors, very finely ground pigments in paste or plasticizers or normal ground commercial pigments.

Decorative lacquers should be selected on the basis of their intended end use. For example, some decorative lacquers may be exposed to sunlight and for this reason color fast dyes or pigments should be used to obtain the desired color. Other decorative lacquers, such as those used in producing milk bottle hood foil, should be able to withstand a slight amount of forming and at the same time be water resistant. The lacquer films for beverage labels including color and pigments may have to resist severe exposure to an alcoholic beverage or to water immersion. When decorative finishes appear on the opposite side of foil to which a heat-seal coating has been applied, the decorative film must withstand the temperatures required for activating the heat-seal coating without becoming discolored, brittle or tacky. Film forming materials and colors of basically different characteristics may be required to obtain these distinctive film requirements.

The eye appeal of aluminum foil makes it an ideal material for ... covers and other decorative applications. It is readily lacquered, ... or embossed.



foil packets offer a high degree of protection
ppliance.

SEAL COATINGS

heat-sealing, adherence and film forming
istics are desirable for all heat-seal coat-
ials. It is also desirable that these materials,
chemical resistance since many of them will
contact with materials that may destroy
characteristics or react with the alu-
foil.

al coatings of the vinyl type are con-
to be the most satisfactory all around
for use on aluminum foil. Heat-seal
ased on cellulose nitrate, ethyl celluloses,
ylates, chlorinated rubbers and rubber
have also been used satisfactorily on
foil.

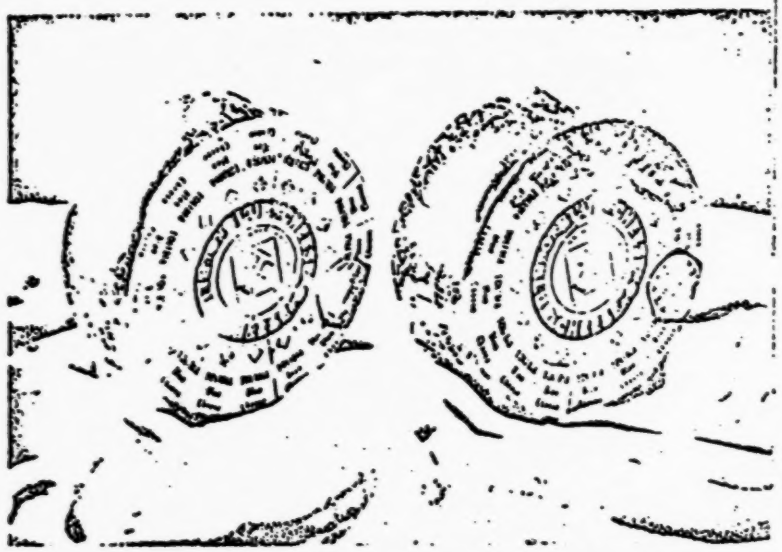
heat-seal coated foils are produced using
ings identified as S-1298 and S-1299. The
mount of Alcoa heat-seal coatings S-1298
9 applied is approximately two grams
housand square inches.

t-seal bond strength between two coated
creases slightly with increased film thick-

nesses. The thicker than normal films are used only in the packaging of small costly items requiring a maximum of care and protection. For the normal heat-seal coatings the bursting strength added to the foil by the coating is not significant. The effect of increasing the coating weight becomes important only above a coating thickness of one mil.

PROTECTIVE COATINGS

Protective coatings may be applied to aluminum foil for protection against chemical attack or against fingerprints or other handling marks, which may detract from the appearance of foil used in decorative applications. For most purposes the heat-seal coatings applied to aluminum foil act in the double role of providing heat-sealing characteristics and protection against chemical attack. For other applications, where heat-sealing is not a factor, a somewhat lighter coating weight (approximately one gram per thousand square inches) may be all that is necessary. It is usually best, however, to consider each application of this type as a separate problem and to select the coating material and coating weight best suited to meet the special requirements. Resistance to chemical attack or to mechanical abuse may also be provided by various transparent packaging films laminated to one or more surfaces of the aluminum foil.



Cheese is one of the many foods packaged in Alcoa aluminum foil to protect its quality. Such foods as cheese, which might react with plain foil, are safely packaged in foil protected with a suitable coating.

ADHESIVES

A wide range of adhesive materials is available for use with aluminum foil, but the special requirements of each job usually restrict the selection. It is necessary that the adhesive material selected adhere well to the foil surface and to the surface of the supporting sheet. Other specific requirements that may affect the choice of adhesives are color, odor, and resistance to heat, cold and moisture.

Adhesives that have been used satisfactorily in laminating aluminum foil to various supporting sheets range from water dispersed starch, casein, casein latex, sodium silicate, glucose and resin emulsions, to thermoplastics in organic solvents, waxes, asphalts and various formulated blends of these materials. For convenience, these adhesives may be classified as: (1) water soluble, emulsions and dispersions; (2) thermoplastics in lacquer type solvents; and (3) hot melts.

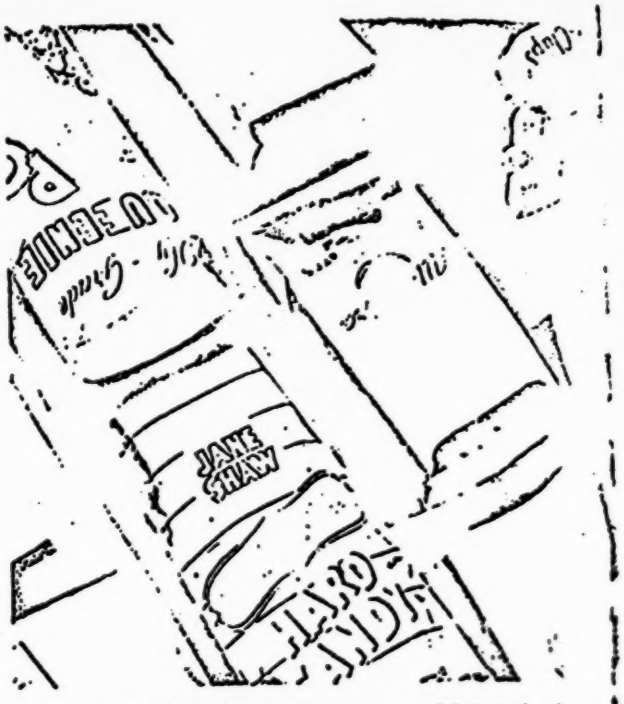
WATER SOLUBLE, EMULSIONS AND DISPERSED ADHESIVES

Adhesives of water soluble or emulsion types in general have been found to be best suited for bonding aluminum foil to papers and other fibrous materials. Since water is a natural wetting agent for papers, this aids in establishing a more permanent bond between the foil and paper for anchoring the adhesive to the outer fibers of the paper stock. Sodium silicate adhesives and starch adhesives, including blends with gums and dextrines, are relatively low priced and may be used in laminating foil to paper for cigarette wrappers, certain types of labels, box wrappers and similar products.

The casein and casein latex formulations as well as emulsions of resinous materials are somewhat more expensive, but allow greater flexibility in fields of application. These adhesives are normally used where strong bonds and resistance to water are required, as in the case of beverage labels and other similar products. As a general rule, they are more water resistant than those of the sodium silicate or starch type.

THERMOPLASTIC ADHESIVES IN LACQUER TYPE SOLVENTS

Thermoplastic adhesives in lacquer type solvents are used primarily with the transparent cellulosic and noncellulosic packaging materials. The nonaqueous lacquer type adhesives consist generally of resins, plasticizers, nitrocellulose or ethyl cellulose. Vinyls and synthetic or reclaimed rubber also may be considered in this group. Adhesives of this type are quick setting and may be formulated to give a long or short tack period after solvent removal and still retain thermoplastic properties.



Aluminum foil is laminated to many materials to produce a foil-covered bags. Effective closures may be obtained by folding, sealing, or heat sealing.

HOT MELT ADHESIVES

Hot melt adhesives used with foil include asphalt, waxes and formulated products. The formulated products may contain a relatively large percentage of microcrystalline waxes modified with latex or resins. Since hot melt adhesives do not contain solvents, drying facilities are not required in their application. Hot melt adhesives offer greater adherence and cohesive strength than does normal paraffin wax. They offer additional resistance to water vapor transfer and are generally satisfactory for use in food wrappers. Because foil may wrinkle under heat, hot melt adhesives are usually applied to the surface of the supporting sheet.

aluminum

its uses ...

s indicated earlier, aluminum foil may be printed
y of the commercial processes used on flexible
ging films. The choice of practice and inks
nds on the conditions to be met. Ink composi-
are varied to meet requirements and are best
dered as specialty items. Inks used in printing
il may be classified as aniline, intaglio and
graphic.

line inks are normally associated with the
of alcohol soluble resins, spirit soluble dyes
ubber plates. Alcohol is one of the least
ful solvents in contact with rubber and is a
solvent for dyes. Shellac is one of the most
only used resins suitable for rubber plate
g. Other alcohol soluble resins with plasti-
may be used and small quantities of alcohol
nitrocellulose can be included. Aniline or
plate printing inks may also include water
, hydrocarbon and mixed solvent formula-
along with oil soluble dyes and opaque
ts. The possible variations in aniline ink
ations along with the Anilox method of
g extend to some extent into the scope of
vure inks which, in turn, approach fast
lacquer formulations.

lio or rotogravure inks permit a wider
of resins and solvents than rubber plate or
inks. Intaglio inks for foil may be best
ed as fast-drying lacquers, formulated to
press and use requirements. Some of the
sed in formulating intaglio inks are shellac,
c, colophony, copal, dammar and synthetic
uch as vinylite, ester gum, glyptals and
s, along with nitrocellulose and other cellu-
mpounds. Solvents used with these resins
much the same type as those used with
ive lacquers. They should, however, be fast
o as to permit the immediate forming of a
, nonblocking film.

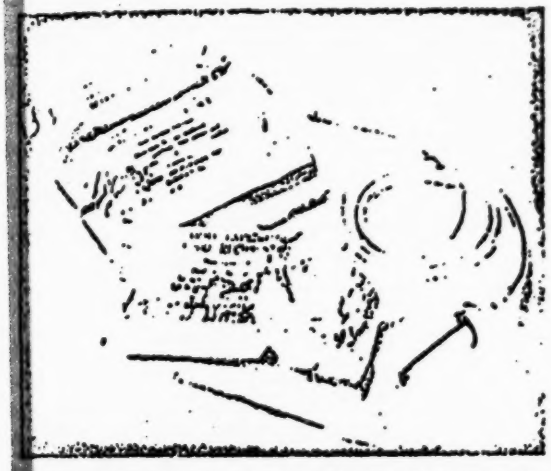
graphic or paste inks are seldom used with
m foil. They are used for printed, coiled
s where the ink is deposited in the recesses
y embossed impressions and drying is not
m. They are also used in printing square
pieces of foil supported by paper and
ard, which are interleaved and allowed to
vernight to dry. These inks normally con-
ious resins, treated and untreated oils,
, driers and modifiers, or wetting and
g agents.

aluminum foil in packaging

Aluminum foil, alone or in combination with various supporting materials, is a versatile packaging material with hundreds of applications. The basic properties of aluminum foil have been outlined in previous chapters. The principal characteristics of foil which recommend it for various packaging applications may be summarized as follows:

1. Impervious to moisture and gases (in thicker gages)
2. Greaseproof
3. Nonsorptive
4. Shrinkproof
5. Odorless and tasteless
6. Hygienic, nontoxic and substantially sterile
7. Resistant to corrosion, nonaging
8. Dead folding
9. Strong
10. Functions well in laminates
11. Appearance, brightness and glitter
12. Reflects radiant heat, opaque to light

While it is not practical to give details of every foil packaging end use, illustrations and laboratory data which support some of these applications will be presented.



Alcoa aluminum foil not only looks clean, but it is also substantially sterile. This is one reason why it is used in packaging many medical products.

HYGIENIC ASPECTS OF ALUMINUM IN PACKAGING

The fact that aluminum is nontoxic and friendly to foods makes it an entirely safe packaging medium. This fact has been established not only by scientific

A wide variety of packaging applications attests the versatility of Alcoa aluminum foil.

The bright appearance and protective qualities of Alcoa aluminum foil make it a favorite material for packaging confections.

...on, but also by long experience, particu-... aluminum cooking utensils. Carefully ... tests have proved that contact with ..., in contrast with the effect of certain ...ds, does not accelerate the loss of vitamins ...g. The loss of Vitamin C during the ...ion of milk in an aluminum container ...greater than when pasteurized in contact ... The loss resulting from heating under ...itions was about 30 per cent, while the ...tion of milk in copper completely de-...amin C. This is only one of the reasons ...num foil closures have proved so satis-... the bottling of milk.

...ACKAGING

...m foil as part of wrappers, bags, cartons, ...ntainers and hermetically sealed packages ... is used in the packaging of a large ... food products. As such, there isn't a day ... luminum foil does not enter the homes ... in one form or another. Some of the ... products that are satisfactorily packaged ..., cheese, oleomargarine, frozen foods, ..., dehydrated vegetables, potato chips, ...sserts, chewing gum, confections and ...ood mixes.

Table 6

RESULTS OF STORAGE TESTS OF WRAPPERS FOR CHOCOLATE NUT CANDY BARS

DESCRIPTION OF WRAPPER	Condition after 25 days' storage at 85-90° F		
	Weight loss in grams	Flavor rating*	Appearance rating*
1. Aluminum foil (0.001") coated with heat-sealing lacquer and laminated on opposite side to acetate sheeting; lacquer coating next to chocolate. This wrapper was heat sealed at seams and ends.	0.5	1	1
2. Aluminum foil (0.001")	1.5	2	2
3. Aluminum foil (0.00045") laminated to waxed glassine paper (0.0015"); waxed glassine paper next to chocolate.	2.5	2	3
4. Waxed paper (0.0022") separate inner wrap; overwrap of aluminum foil (0.00045") wax-laminated to glassine paper (0.0015").	2.5	2	3
5. Aluminum foil (0.00045") laminated to glassine paper (0.0015"); glassine next to chocolate.	2.5	3	3
6. Waxed paper (0.002") separate inner wrap; glassine paper (0.0015") overwrap.	11.0	4	4

*In flavor and appearance, No. 1 is the highest and No. 4 the lowest rating.

CONFECTIONS

The protection of a good wrapper is important in maintaining the quality of items such as chocolate and chocolate candy bars, which should reach the consumer in the freshest possible condition. This means the appearance should be appetizing, texture correct and flavor free from staleness or rancidity.

Figure 12

These two rolled rib roasts were both held in a freezer at approximately 0°F for six months. The one shown in the top picture was wrapped in aluminum foil and the other in waxed parchment freezer paper. The foil wrapped roast retained its freshness while the other developed freezer burn as indicated by its white porous surface.

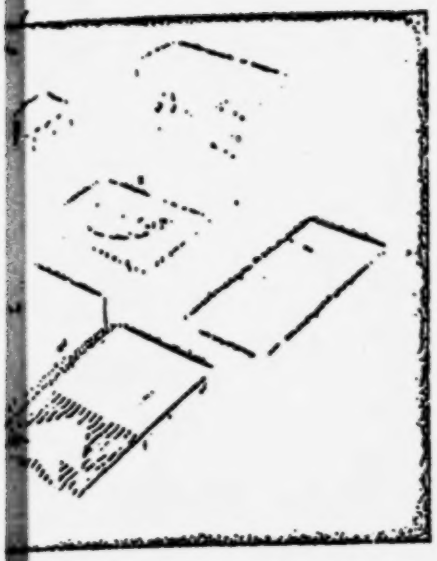
In Table 6 are data from storage tests of chocolate nut bars wrapped in six different types of wrappers and stored for twenty-five days. Performance of these wrappers was judged in several ways: by the weight loss after twenty-five days' storage, by the flavor and by their appearance. The flavor and appearance ratings were appraised individually by three different inspectors. The chocolate nut bar wrapped in plain waxed paper with a glassine outer wrap showed the largest weight loss after storage. This same bar also had an important loss of flavor and appearance. It was distinctly stale in taste and appeared hard and dry with surface crumbling along the edges. Mold was not observed on any of the chocolate bars. Wrapper No. 1, which was a laminated foil wrap with heat seal showed the best performance on all counts. However, all the chocolate bars in the wrappers that employed aluminum foil had a soft creamy texture and were free from staleness. In the case of chocolate and other products where volatile essential ingredients play an important part in flavor and palatability even a very small weight loss may be significant in loss of quality.

It is also important to employ a wrapper that will prevent the absorption of foreign odors by chocolate. A severe laboratory test was carried out in which several milk chocolate bars wrapped in various ways were stored in desiccators containing, in one case, cotton moistened with turpentine, and in another, strong peppermint candy. At periodic intervals the bars were removed, unwrapped and tasted by two or more inspectors in order to determine the first trace of turpentine or peppermint vapor absorption. Results of these tests, shown in Table 7, show definitely that while it was only a matter of hours before the paper wrappers permitted the absorption of foreign odors, the aluminum wrapper kept the odor out for days.

FROZEN FOODS

The packaging of frozen foods places special requirements on the wrapper. The extremely low humidity maintained in the frozen food locker and the long storage periods necessitate a relatively impervious wrapper if desiccation of the product and freezer burn are to be prevented. Storage periods may be as long as twelve to eighteen months.

Aluminum foil wrappers and foil lined cartons are being used effectively in the protection of frozen



wrappers and liners are used effectively in the
oisen foods against the loss of moisture and flavor
orage periods at low temperature and humidity

vegetables. By way of illustration, two
roasts, one of which was wrapped in
foil and the other in waxed parchment
per, were held in a freezer at approxi-
F for approximately six months. Fig. 12
results of this test. The roast wrapped in
foil lost only 1 per cent weight and was
dition for appearance and taste whereas
apped in the freezer paper had lost ten
weight and suffered freezer burn and
in quality.

EGETABLES

aging of fresh vegetables to prolong
life requires the maintenance of their
ontent to preserve freshness and pal-
Green vegetables, in addition, require a
ount of oxygen for respiration if they
succumb to wilt. Carrots are one of the
ables to keep. The following test how-
ates graphically the benefits of protective
Carrots for this test were taken fresh
rden, tops were removed and the carrots
ed. Some of the carrots were packed
rectangular, heat-sealed aluminum foil
bag. This sealed bag was placed in a
refrigerator and beside it were placed

Table 7

EFFICIENCY OF WRAPPER IN PREVENTING FOREIGN ODOR ABSORPTION BY SWEET MILK CHOCOLATE BARS*

DESCRIPTION OF WRAPPER	Time to taste	
	Turpentine	Peppermint
1. Aluminum foil (0.0007") coated with heat-sealing lacquer and laminated one side to moistureproof cellophane; coated surface heat sealed along side seam and ends	20 days	19 days
2. Aluminum foil (0.0007") coated with heat-sealing lacquer; wrapper heat sealed along side seam and ends	6 days	7 days
3. Plastic bleached greaseproof paper 22½#; side seam and folds not sealed	5 hrs	3½ hrs
4. Opaque greaseproof paper 30#, side seam and folds sealed	5 hrs	3½ hrs
5. Control—no wrapper	½ hr	1 hr

*Chocolate bars stored in glass desiccators, one containing cotton moistened with turpentine and the other containing peppermint candy.

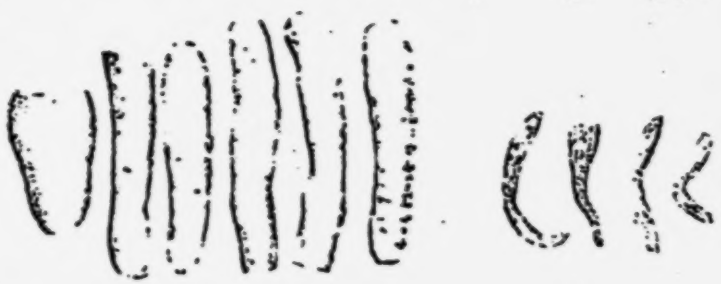


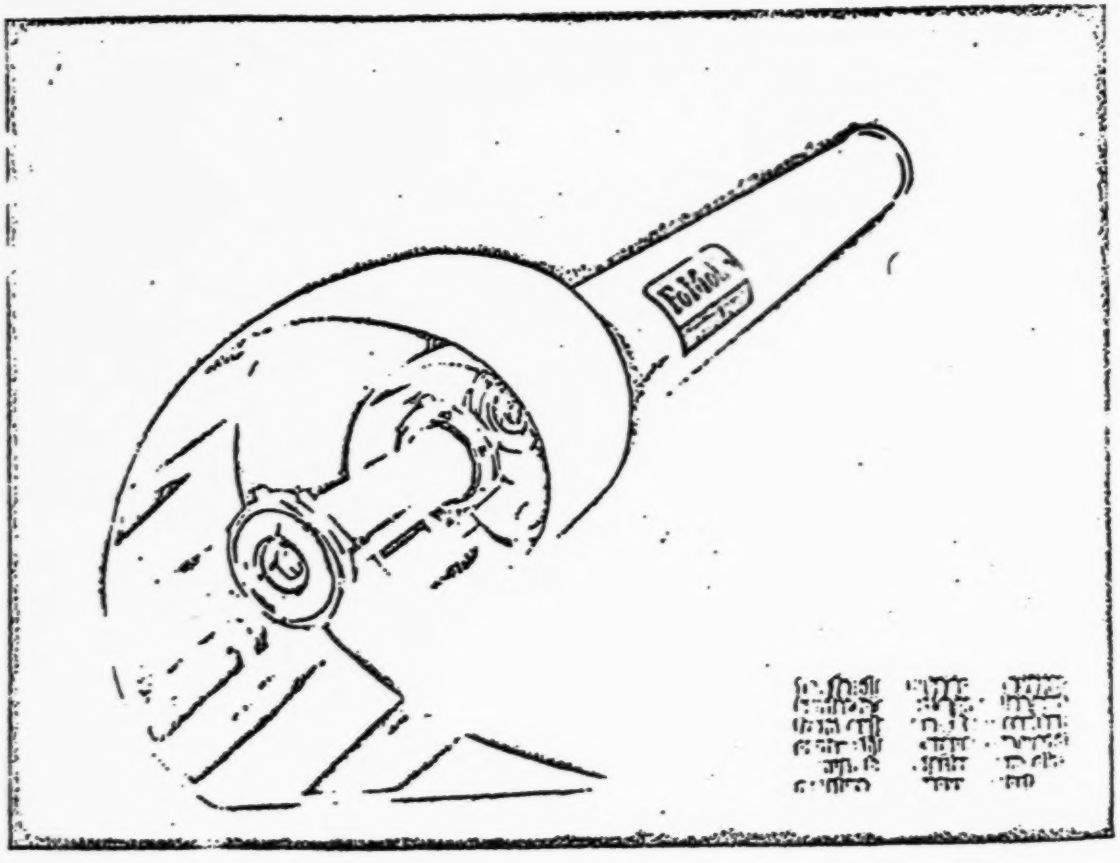
Figure 13
Comparison of carrots after 51 days' storage in a home refrigerator. Carrots at the left were wrapped in Alcoa Aluminum foil; those illustrated

These packages are produced on one of several different styles of heat-sealing equipment. Equipment design, stability and accuracy of construction are factors contributing to efficiency and economy in packing individual packets and small heat-sealing pouches.

ALUMINUM FOIL IN INDUSTRIAL AND MILITARY PACKAGING

Military requirements for export shipments and storage under tropical or arctic conditions stimulated the development of methods of packaging and the tests of packages for overseas shipments. These methods have led to changes in practices for both commercial export shipments and packaging and storage for domestic commercial activities. Aluminum foil has been used in these packaging developments primarily as part of a laminate, but plain foil is also used to advantage for water resistant, greaseproof wrappers. Flexible laminated wrappers containing aluminum foil are available in great variety. The following typical laminates indicate the numerous combinations that are made practical by varying component materials and their thicknesses:

1. Plain foil *plus* paper
2. Heat-seal coat *plus* foil *plus* paper
3. Heat-seal coat *plus* foil *plus* paper *plus* cotton sheeting or scrim
4. Heat-seal coat *plus* foil *plus* plastic film
5. Heat-seal coat *plus* foil *plus* plastic film *plus* cotton sheeting or scrim
6. Plastic film *plus* foil *plus* plastic film
7. Plastic film *plus* foil *plus* plastic film *plus* cotton sheeting or scrim
8. Plastic film *plus* foil *plus* paper
9. Plastic film *plus* foil *plus* paper *plus* cotton sheeting or scrim
10. Plastic film *plus* foil *plus* cotton sheeting or scrim



The selection of a specific sheet may be determined by government or industrial specifications or economic considerations.

Laminated foil wrappers may be used for sealed or unsealed wraps. They are used to produce bags for packaging items as large as airplane motors. Sealed bags are used alone and inside or outside of paper cartons or boxes. Very tough, strong foil-lined bags are used on the outside of fiberboard boxes so that they will withstand service abuse. Foil-lined tubes and other rigid containers are also used for protective packaging.

Packaging materials incorporating foil protect automobile accessories and parts from corrosion. They have been used on such items as cam shafts, starters, oil filters, oil cells, adapters, adjustable nut locks, gaskets and valves. Service groups have used foil laminated bags for the packaging of electronic equipment, radio and radar equipment, spare machinery parts, pharmaceuticals, camera supplies, hypodermic syringes, scalpel knives and sterilized bandages. Foil barriers protect not only by keeping moisture out, but also by keeping preservative gases on the inside.

The use of aluminum foil as a packaging material in this field is best illustrated by the results from a series of tests on wrappers for polished carbon steel bearing races. The results of this test are shown in Table 9. The first two wrappers, Nos. 1 and 2, employ aluminum foil and were very effective in the protection of oiled bearings during storage in a hot, humid atmosphere. Even wrapper No. 1, which was not heat-sealed, did a good job on the oiled bearings. The same wrapper around a dry bearing (No. 3) did not provide complete protection. It would appear that wrapping paper took up moisture and stimulated the corrosion of the steel with which it was in contact. However, foil laminated to paper greatly reduces the rate of moisture pickup and prolongs the protective life of the wrapper. The principles involved in many of the materials packaged and the experiences obtained in the packaging for export shipping by the Military Services are applicable to industrial packaging, shipping and storage problems. Therefore, it is not only reasonable but almost a necessity that many metal products and other articles requiring storage in a controlled environment will be protected with aluminum foil in future commercial packages.

Table 9

RESULTS OF STORAGE TESTS OF WRAPPERS FOR POLISHED STEEL

(Polished carbon steel bearing races, dipped in antirusting oil, excess oil drained and bearings wrapped. Packages stored at 106° F and 90-92% relative humidity.)

DESCRIPTION OF WRAPPER	Degree* of tarnishing after	
	Storage 180 hrs	Storage 1,000 hrs
1. Aluminum foil (0.00035") laminated to 25# red paper with wax; foil next to bearing	0	0
2. Aluminum foil (0.00035") laminated to 25# red paper with wax; foil next to bearing; steel bearings wrapped in foil laminate and heat sealed in bag made from aluminum foil (0.001") with lacquer coating	0	0
3. Aluminum foil (0.00035") laminated to 25# red paper; same as No. 1, except bearings were dry (not oiled); foil next to bearing	1	2
4. Red paper, 25#	1	7
5. Kraft paper, waxed	2	7
6. Waxed paper, 40#	2	9
7. White glassine	10	10 (plus)

*The degree of rusting is indicated by code numbers from 0 to 10. Zero indicates no rusting, while the degree increases from 1 to 10. No. 5 indicates appreciable rusting, while No. 10 indicates a surface which is about 90% rusted.

E24

Table 13

GENERAL FABRICATION LIMITS FOR VARIOUS TYPES OF ALCOA FOIL

Type	Grade	Gages, inch	Coiled widths, inches	Tempers
Foil	BEIS	.00025 to .0003	⅛ to 24	O or H19
	BEIS	.00035 to .005	⅛ to 53	O or H19
	CCIS	.0005 to .005	⅛ to 36	O or H19
	3S	.0007 to .003	⅛ to 36	O or H19
	3S	.003 to .005	⅛ to 48	O or H19
	24S	.002 to .005	⅛ to 20	O or F
	52S	.001 to .005	⅛ to 20	O or F
...ored, ...r decorative	BEIS or 3S	.00035 to .001	⅛ to 25½	O
	BEIS or 3S	.001 to .005	⅛ to 26½	O
...sive Coated, ... side	BEIS or 3S	.00035 to .001	⅛ to 25½	O
...sive Coated, ... sides	BEIS or 3S	.00045 to .001	⅛ to 25½	O
...l Coated, ... tinted:				
...rmal Coat, 1 side	BEIS or 3S	.00045 to .001	⅛ to 25½	O
...rmal Coat, 1 side	BEIS or 3S	.001 to .005	⅛ to 26½	O
...rmal Coat, 2 sides	BEIS or 3S	.001 to .005	⅛ to 26½	O
...uble Coat, 1 side	BEIS or 3S	.001 to .005	⅛ to 26½	O
...avy Single Coat, ... side	BEIS or 3S	.001 to .005	⅜ to 26½	O
...ssed	BEIS or 3S	.00035 to .0015	⅛ to 26	O

NOTE: Maximum length of rectangular foil: 42 inches.
Information on sizes and grades not listed is available upon request.

...RCIAL TOLERANCES Thickness or ...rea, plus or minus 10%.
...inches or over, plus or minus 1/32 inch.
...der 12 inches, plus or minus 1/64 inch.
...r, width and length, plus or minus ...
...tems under 5,000 pounds, plus or minus ... Shipping, items 5,000 pounds or more, plus or minus 5%.

CONVERTERS will supply Alcoa Foil, mounted to paper, paperboard or transparent sheeting by adhesives, wax or glue lines; lacquered, embossed, printed, etc. in form of coiled or flat wrappers, overwraps, labels, bags, envelopes, pouches, packets, covered or lined cartons, etc.

SURFACE FINISH

Single sheet rolling results in a bright finish on both sides of foil.

Pack rolling results in one side being bright and the other side dull finish. Dull finish is also referred to as "mat" or "satin" finish.

Gages .0007 inch and lighter are normally pack rolled.

Gages over .001 inch to .005 inch are normally single rolled.

Gages over .0007 inch to .001 inch may be either single or pack rolled, depending on width, plant of manufacture or customers' preference.

Table 14

STANDARD SPLICES FOR ALCOA FOIL*

GAGES	WIDTHS	TYPE OF SPLICE
PLAIN SOFT *(Annealed)* FOIL:		
.00025" to .0003"	All widths	Mechanical knurl
.00035" to .001"	Under 10"	Mechanical knurl
	10" and wider	Heat-seal foil tape
.0015" to .003"	All widths	Electric weld
.0035" to .005"	All widths	Lapped in loose ends (Electric splice if requested.)
PLAIN HARD *(Not Annealed)* FOIL:		
.00025" to .00035"	All widths	Adhesive tape
.0004" to .003"	Under 10"	Electric weld
	10" and wider	Adhesive tape
.0035" to .005"	All widths	Lapped in loose ends (Electric splice if requested.)
HEAT-SEAL COATED FOIL:		
.002" and lighter	All widths	Heat-seal coating used to splice overlapped ends
Over .002"	All widths	Adhesive tape
LACQUERED *(Except Milk Bottle Foil):*		
Under .001"	All widths	Gutta percha, heat-sealed
.001" and over	All widths	Adhesive tape
MILK BOTTLE HOOD FOIL *(Plain or Lacquered):*		Ends not spliced
ADHESIVE MOUNTED OR EMBOSSED:		
Under .001"	All widths	Gutta percha or two sides coated adhesive tape
.001" and over	All widths	Adhesive tape
WAXED PAPER BACKED:		
.00065" and lighter	All widths	Ends overlapped—wax adhesive
Over .00065"	All widths	Adhesive tape

*Ends in coiled material are spliced by standard methods indicated above unless otherwise instructed. Customers' special instructions will be complied with when requested, if possible.

EXHIBIT BV - ARTICLE - "COATINGS AND COATING METHODS FOR ALUMINUM FOIL" - 1955

...tings and Coating Methods for Aluminum Foil

The types of coatings used for foil, their purposes and applications; methods of application and coating techniques are discussed.

By I. O. ROBERTSON, JR.

Reynolds Metals Company

...IN A ...S OF ...D ON ...

THE VERY substantial increase in aluminum foil production in the past few years has naturally increased the number of problems encountered in its ...t conversion. In the early ...il converting, its end uses ...re in number as compared to ...ed usages, and consequent... problems of converting were ...plex.

...ere a number of applica... as there are now where ... foil did not have to with... pressure abuse, and con... was used unsupported. ... because of the fragile na... light gauge foil, it was often ...ellent to laminate the met... ...er for support. The paper ...ack could be handled with ...ore ease than the non-coated ... permitted more universal ... of foil. If unlaminated foil ...il, its gauge would have ...e greater in order to with... normal handling, and because ...luminum would not have ...mical.

...dhesives used originally for ... paper to the foil were ...ch. These starch adhesives ...ndedly satisfactory because ...mitations in adhesion and ...stance. As foil production ...d became more apparent ...n physical properties would ...e more accentuated into the lam... ...ion due to presence of adhe... ...wider variety of end uses, ... problems of coating tech... ...d the physical characteris... ...e coating and adhesives ...ere pronounced.

...ings can be classified into various types. There are the thermoplastic and thermosetting ones which are applied from solvent solutions. There is also the group applied from 100 per cent solids, commonly referred to as hot melts and waxes.

Thermoplastic coatings generally require only a sufficient quantity of heat to volatilize the solvents used to dissolve the solid components of the coating, whereas thermosetting coatings require heat not only to remove the solvents from the lacquer film but also to convert the coating to obtain its maximum physical properties. Thermoplastic coatings will be tack free to the touch immediately upon removal of the solvents and cooling of the web to room temperature. Thermosetting coatings will remain tacky after the solvent has been removed and until the resin components have been polymerized, oxidized, and/or cross linked by continued heating. A thermoplastic coating is sensitive to heat at any time the temperature approaches the softening point of the resin components of the coating. A thermosetting coating once solidified is an insoluble, infusible mass that no longer softens appreciably below its temperature of decomposition.

Thermoplastics

Of these two types of coatings, the thermoplastic is used more extensively

Some typical coated foil uses. Cream cheese and oleomargarine wraps are coated on both inside and outside to protect aluminum from corrosive action of cheese and oleo. Cleanser label has an overcoat to protect inks from stuffing. Aluminum tray is coated to prevent corrosion of tray from packaged goods. Two envelopes in center employ coatings on inside foil surface for protection and for hermetically sealing. Cap at bottom left is a milk bottle cap. Small bottle at bottom center has coated aluminum closure that withstands autoclaving without discoloration. Tree in lower right hand corner is coated to prevent corrosion of a...num during lamination of the various segments.

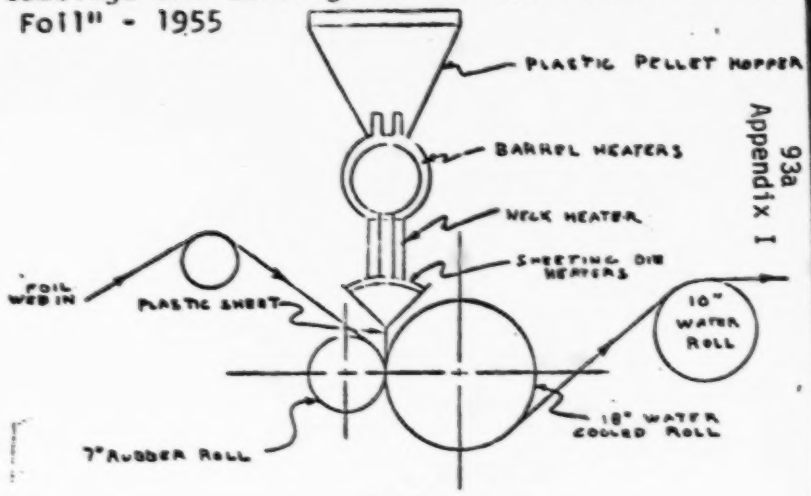


Figure 1
POLYETHYLENE EXTRUDER

by foil converting. This type does not require as large a capital outlay for equipment as does the thermosetting coatings. A thermoplastic coating is usually composed of a film former, a plasticizer, a modifying resin, and in many instances a colorant. The following film formers are used for this type of coating in varying degrees: nitrocellulose, ethyl cellulose, vinyl chloride vinyl acetate-maleic anhydride copolymer, polyethylene, vinyl butyral, cellulose acetate, cellulose acetate butyrate, vinyl chloride, vinyl acetate, vinyl chloride-vinyl acetate copolymers, chlorinated rubber and vinylidene chloride.

Of these resins, the first four are the most widely accepted, with the nitrocellulose and vinyl polymers being used most extensively. There is a tremendous number of plasticizers and modifying resins that can be incorporated in nitrocellulose solutions to give them almost any desired physical properties. Nitrocellulose coatings are used on foil for such finished products as gift wrap, florist foil, seal and label stock and many other items.

Dyes and Pigments

For many applications the nitrocellulose coating decorates the foil surface, and consequently, it must be colored a variety of shades. These colors are developed in two ways, namely, by the incorporation of dyestuffs or pigments into the coating. The end use will determine whether a dye or pigment is used. However, a general classification would be dyes for brilliance and transparency when light fastness is not a requirement, pigments when light fastness is important. The pigments do not provide as transparent a film as dyes, although certain selected pigments are very close to dyes in this characteristic. Pigments are also desired to develop certain deep shades such as greens, blues, purples, opaque oranges, yellows and black and white.

The use of dyes is most preferred because of the ease of adding them to a clear lacquer. Dyes, whether they be alcohol or oil soluble, are merely dissolved in the appropriate solvent, and added to the clear lacquer. Pigments on the other hand require mechanical working to get them properly dispersed into the lacquer resins. The equipment used for this dispersion include pebble or ball mills, three-roll or five-roll ink mills, bambury grinders, or two-roll mills.

Overcoatings

There are instances where colored coatings have to be protected against excessive abrasion. This protection requires the use of a clear overcoat. In determining the type of overcoat, consideration must be given to the effect of the solvents in the overcoat on the nitrocellulose or other types of coating used. The most universal overcoat used for nitrocellulose is formulated with an ethyl cellulose film former. The solvents necessary to dissolve ethyl cellulose are not active solvents for nitrocellulose and therefore bleeding or insipient lifting is no problem.

Ethyl cellulose is also used by itself as a coating for aluminum. This film former, being soluble in a blend of solvents with a very high hydrocarbon content, is especially adaptable to metals with a slight residual oil film on the surface. The hydrocarbon has a tendency to wash the metal and thus enhance the adhesion of the ethyl cellulose to the foil. This coating can be used for the same purposes as the nitrocellulose and, in addition, in applications where resistance to mild alkali is required.

Vinyl Polymers

For the best protection against acidic and alkaline products, the vinyl polymers are most generally employed. The vinyl polymers cover a wide variety of resins, but there is only one that has the desired properties for a foil coating. The vinyl acetate, vinyl chloride polymers and copolymers do not have good adhesion to aluminum. Consequently, a vinyl tripolymer tailor-made to have adhesion to aluminum has been adopted. This resin has excellent adhesion to aluminum and, when stabilized properly, finds a wide variety of uses. It is employed most frequently to protect the aluminum foil from certain types of moist, fatty, and highly seasoned products. It also finds application in the decorative field when the coated foil is to be subjected to outdoor exposure.

Polyethylene

The resin which is having the most rapid growth as a coating for aluminum today is polyethylene. This inert

Meet the author . . .

I. O. Robertson, Jr. is a graduate of Virginia Polytechnic Institute, having received a BS Degree in Chemistry. He attended graduate school at the University of Virginia for two years. For the past eleven years he has been associated with the Research and Development Department of the Reynolds Metals Company, concentrating on the development of inks and coatings for aluminum foil. For the past several years he has been Head of the Plant and Sales Service Group. This group has as one of its responsibilities, the development of papers, adhesives, inks, coatings, used in conjunction with aluminum foil.

g alloids protection under prac- all conditions including those freezing temperature. It can be used as a sealing media to ...kes or envelopes

...thylene foil combinations are ...e wide acceptance in the food ...aging industry. This film forms ...xcellent heat sealing media in ...tion to protecting the foil from ...k in most packaged products.

...ith the present emphasis on long ...storage of military articles, poly- ...ene is finding extensive use as a ...ponent of foil packaging materials. ...ves both as a heat sealing media. ...also as a laminate to bond a ...n cloth to the outside foil surface. ...plication of this type withstands ...temperature exposures of -70- F. without becoming brittle and ...temperatures of 160-deg. F. ...out blocking. A combination of ...thylene film, aluminum foil, and ...n cloth is now being used suc- ...fully to meet certain rigid require- ...ts of the armed services.

Extrusion Coating

Polyethylene, being an inert mate- ...l cannot be applied to the metal ...the same manner as the film form- ...mentioned previously. It has to be ...ied from a molten state. At first, ...s presented an application problem ...only the very low molecular weight ...mers could be applied with the ...mal hot melt equipment. The low ...lecular weight polymers have very ...r film characteristics, and there- ...e are of no practical value when ...d alone.

A new coating technique, molten ...trusion, was developed for applying ...gh molecular weight polyethylene ...ich possesses all of the desired ...n forming properties. Essentially this ...ess consists first of introducing ...nulated polyethylene into a hopper. ...e resin is carried by a screw ...ough a heated chamber maintained ...ove the melting point of the resin. ...As soon as the polyethylene becomes ...id, it passes through screens, down ...chamber perpendicular to the ...reen, and into a die. The opening ...the die is maintained anywhere ...tween three to ten thousandths of ...an inch, depending upon the gauge ...f film desired. The back pressure ...forces the molten polyethylene ...ough the die opening. Very near ...he opening, the foil and film are ...rought together under pressure with ...an excellent bond being secured. As ...there are no solvents to be removed ...from the extruded film, high speeds ...can be maintained on the equipment. (*See figure I.*)

In any review of foil coatings, con- ...sideration must be given to the tech- ...niques of coating and the problems involved. The equipment used in foil coating is specially designed for high speed production. The coatings therefore must be formulated to allow almost instant release of the solvents.

There are various methods for applying a coating to the surface of the metal. The one most used today employs the rotogravure principle. The coating to be applied is formulated with low viscosity resins to permit the application of a high solids coating at the proper solution viscosity. The solids of the coating is an important factor for it affects the quantity of coating that will be retained on the foil surface after evaporation of the solvents in drying. However, a characteristic even more important than the solids, is viscosity. The rotogravure principle is developed around the viscosity of the coating to be used, for it controls the uniformity of the coating on the foil surface.

Rotogravure Coating

For rotogravure applications, the coating is placed in a pan at a predetermined viscosity. A machined or etched cylinder, commonly classified as a knurl, revolves in the pan of lacquer. (*See figure II.*) The coating knurl has been mechanically or photographically worked with a design developed for coating. The three most prominent designs are termed as quadrangular shape cells, triangle-helix shape cells, and line screen. A cylinder having quadrangular shape cells is composed of a number of cells systematically arranged and worked to a specific depth, dependent upon the quantity of coating to be applied.

There are a range of quadrangular shape cell designs available, varying from a No. 10 with a depth of .017 inches, and using 132 cells per square inch, to a No. 304 with a depth of .0000 inches, and using 47,089 cells per square inch. One of the designs used on foil is a 120 quadrangular shape cell having 6,724 cells per square inch of surface area with a cell depth of .0032 inches. This knurl will apply approximately five pounds of 100 percent solids coating per ream to the foil.

In foil converting various ream boxes are employed, one of which is 480 sheets, 24 by 36 inches in size. This ream has an area of 414,720 square inches. On all coatings applied from a solvent system, the quantity of coating to be applied to the metal can be calculated. For example, using a 120 quadrangular shape cell, a 25 per cent solid lacquer will apply approximately five pounds of wet lacquer and therefore 1.25 pounds of dry film per ream.

A triangle-helix shape cell knurl is composed of a series of hills and valleys, and the designations are numerical. For example, a knurl using 84 triangle-helix shape cells will have 84 hills and valleys to the linear inch of surface area running diagonally around the circumference of the cylinder. The depth of the cell in this particular design is .0039 inches, having an angle of 36-deg. There are a range of triangle-helix shape cells ranging from a No. 24 having a depth of .014 inches, and a cell angle of 38-deg. to a No. 120, having a depth of .0022 inches with a cell angle of 45-deg. A knurl having the 84 triangle-helix shape cell design will apply approximately 10.5 pounds of a 100 per cent solids coating, thus a 25 per cent solids coating will apply 2.5 pounds of dry coating to the foil.

A line screen knurl or printing cylinder, as it is more commonly termed, is not a machined cylinder but is photographically etched. It is composed of cylindrical cells which are etched to a specified width of cell to width of wall ratio. For example, a 3-1 cell to wall ratio refers to a cell that is three times the width of the cell wall. The normal depth of the cells vary between .001 and .0015 inches. The width of the cell wall determines to a great extent the depth

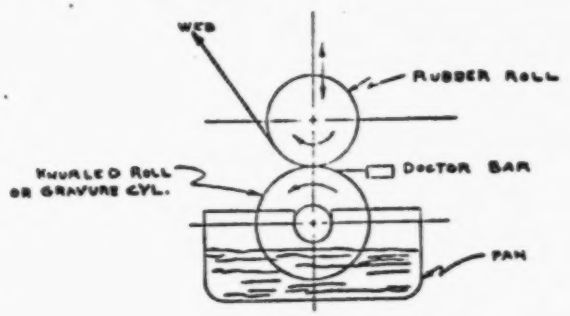
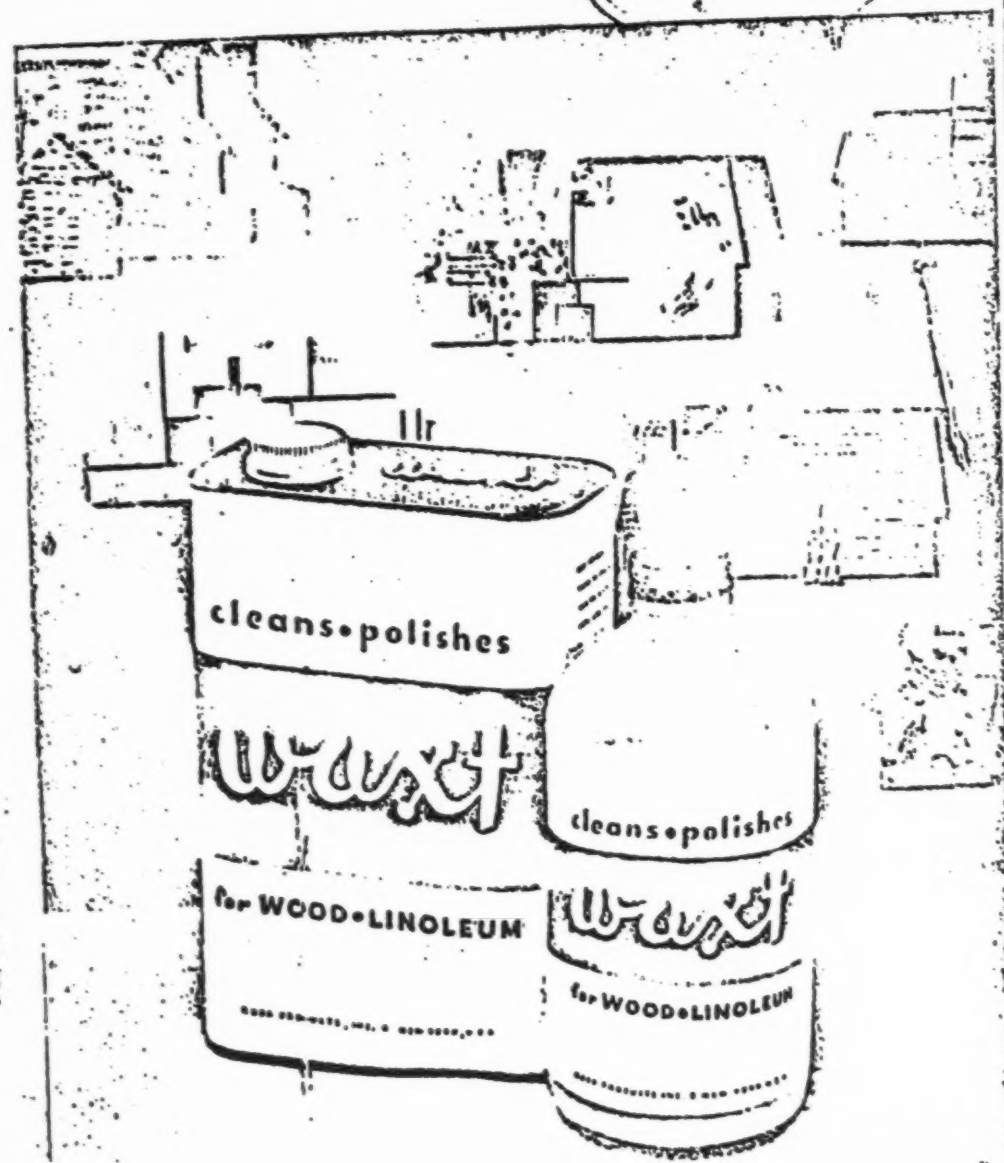


Figure II
GRAVURE TYPE COATER

Modern Packaging



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the 15th of each month by Mod-
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iption $5.00 per year in United
nadian, $5.50; foreign, $6.00.
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e this issue, 50¢ per copy.
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et of June 5, 1934, at Easton,
ized October 7, 1936.

PACKAGING is regularly in-
the *Industrial Arts Index*.

THE PACKAGE SMASHERS

"THE POSTAL AUTHORITIES," said a recent letter to our Reader Service, "have developed their package-smashing machinery to such a high degree of technical efficiency that we are forced to look to you for help."

We could only suggest to this reader that he purchase the best possible shipping-package materials, cushion his product carefully and hope for the best. Apparently the Post Office Department takes the same view.

After numerous complaints, the Toilet Goods Assn. recently conducted a canvass of members which revealed a staggering increase in parcel-post loss and damage in the last year. A letter to the Post Office Department brought a reply pointing out that there has been an unprecedented volume of shipments in recent months; that unavoidable congestion and delay at transfer points has resulted and—in effect—that faith should be put in the package and not in the tender care of overworked mail handlers.

Soaring loss and damage figures are not peculiar to parcel post, but are noted in every type of shipment—and, with the enlarged European-aid program putting new strains on our transportation system, the situation is likely to get worse before it gets better.

Fortunately, good quality shipping-container and packing materials are once more available. The place to attack the shipping-loss problem is in your own shipping room. Stay away from inferior packaging materials. Make sure that extra cushioning is provided at all points of immediate contact with outside shock. See that your products are so securely protected as to withstand the most brutal kind of handling—because that's what they're going to get for a long time yet.

The Editors

TECHNICAL
ENGINEERING & RESEARCH DEPARTMENT

LUMINUM FOIL

I—Its properties for packaging

By JUNIUS D. EDWARDS* and D. B. STROHM†

ordinary progress has been made in recent
rs in applying the tools of science and the
of research to the art of packaging. No longer
ducts be merely wrapped or placed in con-
The hazards of storage and shipment can be
l reliably and the package designed and con-
to afford adequate protection. In the solu-
the problems facing the packaging industry,
n foil has been extremely serviceable. Devel-
in this field continue under the impetus of
y and plant investigations. This article will
summary of up-to-date information on the
nt properties of aluminum foil in the various
which it is employed for packaging.

ical properties

num foil is, in effect, aluminum sheet which is
0.006 in. in thickness. For packaging, the
mmonly used gauges run from 0.0015 in. to

Director of Research, Aluminum Co. of America, New Kensing-
ng Chemist, Packaging Laboratory, Aluminum Co. of America,
N. J.

is the first of a series of three articles
ituting a summation of years of re-
h by one of the leading producers of
inum foil. We predict that it will
l as the definitive reference on this
ct for a long time to come. The first
e presents data on mechanical proper-
water-vapor transmission rates, re-
vity for light and radiant heat, hygienic
teristics, resistance to corrosion and
vital information.—ED.

0.00035 in. One cubic inch of aluminum weighs about 0.0975 lb., so that one pound of aluminum foil of 0.0005 in. thickness has a covering area of 20,500 sq. in. Thinner gauges will, of course, have proportionately larger covering areas and thicker gauges smaller covering areas. Aluminum foil is rolled in widths up to about 36 in.

The reduction of sheet aluminum to foil gauges is accomplished by cold rolling and this cold working of the metal increases both strength and hardness. This, however, is accomplished with a loss of ductility and for most applications aluminum foil is annealed to put it in the soft condition. The tensile strength of annealed aluminum foil 0.001 in. thick is about 8.5 lbs. per inch of width. The annealed foil is dead-folding, which is an advantage in many packaging operations.

With constantly increasing interest in the storage of products at low temperatures, it is important to know that aluminum foil does not become brittle at low temperatures. In fact, recent measurements show that aluminum increases in strength and ductility as the temperature is lowered, even down to minus 320 deg. F.

The tearing strength of the thin gauges of aluminum foil is relatively low; however, by bonding aluminum foil to other materials, such as plastic films, paper and paperboard, a laminated product can be produced which has good strength and resistance to tear.

Water-vapor transmission of foil

An outstanding development of modern packaging practices is the control of the gas and moisture contained within a package. Usually this means control of the moisture content and the desired condition may vary over a wide range, depending on the material being packaged. In the case of tobacco and various food products, for example, the aim may be to maintain the moisture content within some preferred range. In the

PASS in a series of breakdowns in ing mills by means of which coiled m sheet is converted into form of foil.

steel products, such as ball bearings, cutlery, nim may be to maintain an atmosphere of very nidity to prevent rusting. This practice has yond the control of moisture content and now packaging in controlled atmospheres contain- on dioxide, nitrogen, etc.

ermeability of packaging materials to gases has, ently, become an important consideration and lized techniques for the measurement of gas bility are available. Aluminum, the metal, is ous to gases and this characteristic offers an nt advantage to the package designer. It must nized, however, that not all gauges of aluminum ve zero water-vapor transmission. In thick- below about 0.0015 in., foil will contain minute s. In the very thin gauges of foil, such as in., these pinholes will be of sufficiently frequent to permit an appreciable rate of moisture diffusion. However, as the foil thickness increases, the number of pinholes in any given area decreases and the size of pinhole also decreases. These pinholes seem to be an inevitable result of rolling metal to such a thin gauge; the best of rolling practices seem able only to control their size and number.

An idea of their effect upon water-vapor transmission is given by the data in Table I, which presents characteristic WVT values for foil of four different gauges. In making this test, 100 sheets (12 in. square) of each gauge of foil were taken and every tenth sheet tested for WVT. In the case, however, of the 1-mil foil, only eight of the 100 sheets showed pinholes in the test; in the case of 0.0007-in. foil, only 15 of the 100 sheets showed pinholes. In the two heavier gauges, only three pieces of the 0.001-in. foil and eight of the 0.0007-in. foil, respectively, had pinholes in the center area, where their effect on WVT could be measured. The data of Table I clearly illustrate the fact that there is considerable variation in the WVT of different test pieces of the same gauge aluminum foil. This is to be expected, of course, since any pinholes present are uniform neither in size nor in distribution. The averages, however, clearly indicate the trend toward lower per-

TABLE I—WATER-VAPOR TRANSMISSION OF ALUMINUM FOIL

Thickness of foil (in.)	*WVT (gm. H_2O per 100 sq. in. per 24 hrs. with air at 100°F. and 100% R. H.)*	*Thickness of foil (in.)*	*WVT (gm. H_2O per 100 sq. in. per 24 hrs. with air at 100°F. and 100% R. H.)*
0.00035	0.62	0.0007	0.07*
	0.11		0.08
	0.20		0.06
	0.23		0.05
	0.15		0.04
	0.69		0.08
	0.29		0.01
	0.34		0.04
	0.18		
	0.07		
	Average 0.29		
0.0005	0.08	0.001	0.02*
	0.05		0.03
	0.06		0.02
	0.12		
	0.15		
	0.09		
	0.13		
	0.31		
	0.17		
	0.04		
	Average 0.12		

Gauge of foil (in.)	*Number of 12 in. square sheets with pinholes*	*Number of sheets with no pinholes*
0.00035	100	None
0.0005	100	None
0.0007	15	85
0.001	8	92

* WVT values not averaged because majority of the 100 sheets examined had zero permeability.

...as the thickness of the foil is increased. The ...st area for the permeability measurements ...Table I and elsewhere in this paper was ap... ...y 10 sq. in.

...thod employed in measuring the permeability ...aterials to water vapor is essentially that de... ...viously in this journal (1)[1]. A glass test dish, ... calcium chloride desiccant, is closed by the ...rane which is wax-sealed at the edges. The ...after weighing, is supported in a chamber filled ...of the required temperature and humidity; ...maintained in positive circulation with a fan. ...asured period, the water-vapor transmission ...ned by weighing.

...a foil laminates

... has been made of the practice of bonding ... foil to other materials to produce laminates ...esired combination of characteristics for con... ...l wraps. These materials are usually paper ...board of wide variety and plastic films of ... kinds. In producing laminates with very ...bility, it is important that good adhesion be ... the foil. For this reason, the adhesive se... ...ld be adapted to the materials to be lami...

...e laminate is made with paper or paperboard, ...spersed adhesive such as sodium silicate, ca... ... latex or an emulsified resin composition may ...ed. Adhesives of the hot-melt type have ...ound particularly useful for this application; ...hesives comprise amorphous waxes, used ...dified with resins. Asphaltic adhesives are ... for some laminates.

...ating plastic films with aluminum foil, it is ... important that the adhesive adequately ...il and plastic. Consideration must also be ... the fact that the foil is nonadsorptive and ...e to solvent. This means that the adhe... ... be selected for the specific plastic-foil com... ... be laminated. For example, nitrocellulose... ...ves find particular application in laminating ...and other cellulosic films, whereas vinyl... ...ives have been found quite satisfactory for ... certain other types of plastic films. Ad... ...loyed with plastic films are generally of the ...ic type, applied from solution or dispersion.

...foil laminates

...hanisms by which water vapor penetrates ...tic films are quite different. In the case of ...il, water vapor penetrates by diffusion, but ...h openings such as pinholes. In the case ...lms, water vapor penetrates through the ...of the film by solution in the plastic and dif... ... one side to the other. The WVT rate is ...by the composition of the film and its thick... ...se of the difference in the method of pene... ...*binations* of aluminum foil and plastic sheet... ing offer very effective barriers to water-vapor and gas transfer.

If the foil is on the side of high humidity, water-vapor penetration is limited to the area of the pinholes. If the other side of the foil is covered with plastic sheeting and the adhesion between foil and plastic is complete, then the only areas of the plastic exposed to gas transfer are those areas outlined by the pinholes. For example, the measurements referred to on 0.00035-in. foil showed a total pinhole area of approximately 0.00004 sq. in. in 100 sq. in. of foil. Thus an extremely small area of plastic is exposed to water vapor and the moisture-excluding efficiency of the laminate is very high.

There are several problems involved in securing complete lamination of foil to plastic, but even though the plastic does not adhere to the foil at every point, a very effective combination can be secured. In Table II are given data showing the water-vapor transfer of foil laminated with two different types of plastic. These are commercial materials and examination showed that adhesion was generally good, though not complete. For comparison with these values another series of tests was run showing the permeability of the same foil and plastic simply laid one over the other without a laminating adhesive between. In this latter series of tests, any water vapor penetrating the foil could diffuse between foil and plastic and have the whole test area of the plastic available for water-vapor diffusion. Ten test pieces were run in each series to show the agreement between replicate samples. These data show that while good adhesion between foil and plastic is necessary for the most efficient barrier, water-vapor transfer is quite limited even when the foil and plastic are not laminated but form two barriers "in series," so to speak. As would be expected, these tests show that the

SKILLED OPERATORS and precision equipment are required to maintain uniform foil thicknesses. Here a strip of heavier-gauge aluminum foil is undergoing another breakdown pass.

mplete the degree of adhesion between the foil stic, the less important is the permeability of stic film.

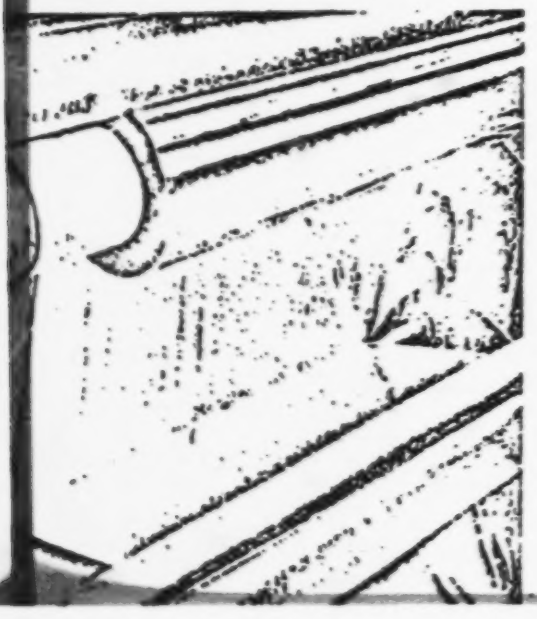
ented papers, as a rule, offer very little resistance re-vapor passage. As a result, combining paper uminum foil, particularly when it is attached by es and not an over-all adhesive, results in very

E II—EFFECT OF ADHESION BETWEEN FOIL HEETING ON PERMEABILITY OF LAMINATES

	Permeability (gm. H_2O per 100 sq. in. per 24 hrs. at 100°F. and 100% R. H.)	
Description of material	Laminated with all-over adhesive	Foil laid on plastic film—no adhesive
um foil (0.00035 in.) in nation with moisture- cellophane sheeting	0.019	0.136
	0.019	0.117
	0.011	0.058
	0.012	0.083
	0.013	0.107
	0.019	0.110
	0.020	0.100
	0.021	0.011
	0.014	0.010
	0.021	0.013
	0.017	0.081
m foil (0.00035 in.) in nating with acetate ng	0.001	0.254
	0.012	0.019
	0.021	0.015
	0.037	0.153
	0.018	0.050
	0.005	0.005
	0.015	0.200
	0.029	0.203
	0.029	0.413
	0.012	0.183
	0.018	0.150

Permeability—foil, 0.2; cellophane, 0.45; acetate, 42.0.

ROLLING can be used with foil in its gauges. Two layers of aluminum foil ed simultaneously through the rollers.



little change in the permeability of the foil. In the case of one particular lot of 0.00045-in. foil which was laminated to 35-lb. bond paper by widely spaced glue lines, the permeability of the composite product was only 15% less than that of the foil alone. That the reduction in permeability was not greater is not surprising since the paper alone, under standard tests, had a WVT of 325 gm. per 100 sq. in. per 24 hrs.

The data of Table III show that with proper laminating techniques and proper selection of materials, foil-plastic laminates having WVT values as low as 0.00 can be secured. To secure a laminate of uniformly low permeability, it is desirable to use one of the heavier gauges of foil, such as foil 0.001 in. in thickness.

TABLE III—WATER-VAPOR TRANSMISSION OF ALUMINUM-FOIL LAMINATES

Material	Thickness (in.)	Permeability (gm. H_2O per 100 sq. in. per 24 hrs. at 100°F. and 100% R. H.) Flat	Creased*
Aluminum foil laminated	0.00035	0.00	...
with moistureproof cello-	0.0009	0.01	0.03
phane		0.01	0.01
Aluminum foil laminated	0.00035	0.01	...
with cellulose acetate	0.0012	0.02	0.07
Aluminum foil laminated	0.00035	0.01	0.01
with rubber hydrochloride	0.0008	0.01	...
Aluminum foil laminated	0.00035	0.01	0.02
with vinyl polymer	0.0012	0.02	0.01
Aluminum foil laminated	0.00035	0.00	0.04
with wax to 30# glassine			
Aluminum foil 28-0	0.00035	0.07	0.42
Aluminum foil laminated	0.001	0.00	0.00
with moistureproof cello-	0.0009		
phane			
Aluminum foil laminated	0.001	0.00	0.00
with vinyl polymer	0.0012		
Aluminum foil laminated	0.001	0.00	0.02
with wax to 25# glassine			
Aluminum foil 28-0	0.001	0.00	0.40

NOTE: Each value in this table is the average of measurements on two or three test pieces. In some cases, two or more lots of laminates were tested.
* These test pieces were creased with four equidistant parallel folds and then with four more folds at right angles to the first; there were thus 16 crease intersections on the face of the test pieces.

Permeability of foil laminates to CO_2

Because of the interest in the use of carbon dioxide as an inert atmosphere in packaging, a series of measurements has been made on the permeability of two aluminum-foil laminates to this gas; these data are presented in Table IV. For comparison with the data on the laminates, permeability figures are presented for the plastic films alone. The evidence is quite convincing that although the plastic films alone show an appreciable permeability, the foil laminate is quite impervious to penetration by either carbon dioxide or water vapor. These data supplement the information presented in Table III.

Reflectivity of aluminum foil

A clean aluminum surface of high purity will exhibit a reflectivity for white light of approximately 90%. Commercial aluminum foil (Table V) may develop a

vity as high as 88%. There is a tendency for the r, more highly burnished foils to exhibit the reflectivities. In the case of embossed foils, the vity generally runs about 80 to 86%, depend- the particular foil and pattern employed. These rements show the consistently high reflectivity mercial aluminum foil.

IV—PERMEABILITY TO CARBON DIOXIDE ATER VAPOR OF ALUMINUM FOIL LAMI- NATED TO FILMS AND OF FILMS ALONE

Material	Permeability (cm. per 100 sq. in. per 24 hrs.*) CO_2†	$CO_2 + H_2O$	H_2O
m foil (0.00035 in.) ated to moisture- relhplate	0.001	0.001	0.000
m foil (0.00035 in.) ted to vinyl poly-	0.001	0.005	0.001
ne alone	0.030	0.193	0.197
lymer alone	1.78	4.18	2.72

ed values are the average of concordant measurements on four dif- s pieces at a temperature of 77 to 81 deg. F. ability to carbon dioxide measured at 760 mm. pressure difference; side in next column was saturated with water vapor.

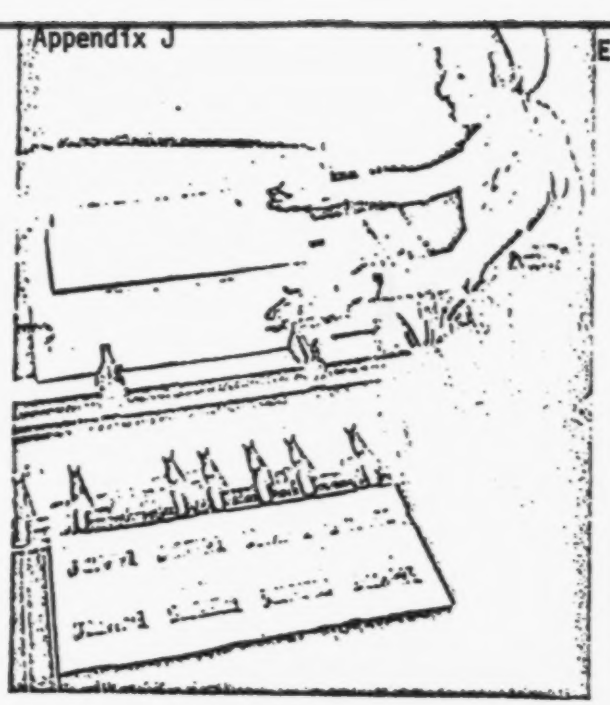
inum foil in the thinner gauges may be produced k-rolling, that is, two sheets may be passed h the rolls together. The surfaces in contact e rolls will be burnished, but the two faces of the ich are in contact with each other have a some- duller surface and one which is more diffusing in ter. While embossing may not seriously reduce tal reflectivity, it does reduce the specular re- n from the surface and correspondingly increases fuse reflection. For many applications, this in- in diffuse reflectivity is a desirable one from the oint of appearance.

V—REFLECTIVITY OF ALUMINUM FOIL FOR LIGHT
(Light from tungsten-filament lamp)

Description of foil	Total reflectivity (per cent)
minum foil—0.0005 in.	87
minum foil—0.001 in.	88
minum foil—0.002 in.	82.5
minum foil - 0.005 in.	82
l foil - 0.00045 in.- bright	86.5
l foil—0.00045 in. - medium	81
l foil 0.00045 in.—dull	80.5

high reflectivity of aluminum foil may be com- lly important because of the bright metallic nce which it contributes. The high reflectivity so be of advantage under some circumstances in izing the temperature rise in a package when d to the heating effects of sunlight or other ra- nergy.

reflectivity will be reduced by coating with syn- resin or laminating with plastic films. The t of the reduction will vary, depending on the characteristics of the material employed. Cer- tics, such as the methacrylate resins and cellu-



PRINTING on foil can be done by any of the commercial processes. Here operator feeds embossed, paper-backed foil to flat-bed press.

lose acetobutyrate, are quite transparent to light and effect a minimum reduction in reflectivity.

Aluminum foil, of course, is opaque to light.

For reflecting thermal radiation such as from a hot stove or radiator, aluminum foils have even greater efficiency. For long wave length (infra-red radiation) of this type, the reflectivity of aluminum foil may be as high as 97%. Correspondingly, its emissivity or radiating power for radiation of this same wave length will be 3%. For thermal radiation of this type, the reflectivity (and emissivity) is substantially changed by any nonmetallic coating such as resin or plastic film of appreciable thickness.

Hygienic aspects of aluminum in packaging

The fact that aluminum does not produce any toxic effects makes it an entirely safe packaging medium. This fact has been established not only by scientifically controlled experimental investigations, but also by long experience, particularly with aluminum cooking utensils. Carefully controlled tests have proved that contact with aluminum, in contrast to a number of other metals, does not accelerate the loss of vitamins in cooking. The loss of vitamin C during pasteurization of milk in an aluminum container was no greater than when pasteurized in contact with glass. The loss due to heating under these conditions was about 30%, while pasteurization of milk in copper completely destroyed vitamin C (2). This is only one reason why aluminum foil caps have proved so satisfactory in the bottling of milk.

Another advantage of aluminum foil is the sterile character of the surface which results from [illegible] at a temperature of about (*Continued on page*

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Tin restrictions issued

The long-awaited tin-conservation order made its appearance on Jan. 30, in much milder form than had originally been expected. In general, it merely restricts can manufacturers to the use of no more tin in 1948 than was used by them in 1947. The announcement of the Department of Commerce order stated that it was designed to save 2,750 tons of tin for the nation's dwindling strategic stock-pile.

The order forbids entirely the use of tinplate cans for coffee, forcing that product into non-tinned metal, glass or paper. Motor oil is allowed no one-quart tinplate cans, although terneplate may be used. Animal foods are restricted to no more than 75% of the tinplate coating used in 1947 or 1941, whichever is larger, and are allowed no tinplate can ends. Pigmented oil paints may use no cans with a tin coating heavier than 0.25 lb. per base box, but terneplate may be substituted.

The use of cans for beer is in effect frozen at the 1947 level by a provision that beer may use no more tinplate than it used in 1947.

The order will become effective Feb. 29 only if Congress extends government controls on tin beyond that date, but this action is generally expected.

Aluminum foil

(*Continued from page 147*) 700 deg. F. Aluminum foil is also odorless, tasteless and does not absorb odors from the surrounding atmosphere.

Resistance of aluminum to corrosion

The resistance of aluminum to attack by various materials is an important consideration in some applications of aluminum foil and other aluminum products used for packaging. There are certain conditions met with in packaging which may have a significant effect and which sometimes make necessary a special appraisal of a new packaging problem. Such factors as temperature of storage of the package, probable time of storage, thickness of the foil, etc., must be given careful consideration. Aluminum foil is unaffected by sunlight, is noncombustible and, being nonsorptive, does not exhibit dimensional change with change in the humidity of the atmosphere. While intermittent contact with water generally has little action on aluminum, moist or hygroscopic products packed in thin foil may cause some reaction, particularly if the product contains salt, or salt and some organic acid, as in the case of cheese. The action may be quite severe and require a protective coating on the metal. Solutions of heavy metal salts, such as those of copper, nickel, tin, etc., have a corrosive action on aluminum. Soaps and detergents are generally sufficiently alkaline so that they attack the natural protective oxide film on aluminum and it becomes necessary to pack them in coated foil. Oils and greases, as a rule, have little or no action. How-

over, the only safe rule is to make a packaging test in the case of any new type of product.

Aluminum foil may be coated with lacquers and synthetic-resin coatings of various kinds. It is common practice, for example, to apply colored lacquers to foil for decorative purposes. These lacquers are usually made with a nitrocellulose base and are the quick-drying type, so that the foil may be coiled immediately after lacquering. Usually the lacquer is colored with a dye. These coatings, generally thin, offer little protection.

Where the foil must be heat sealing, a synthetic-resin coating of the thermoplastic type is employed. The resin should, of course, be selected to give adequate sealing within a permissible temperature range. For some purposes, foil is given a heat-sealing coating on one side and laminated on the other side to a thermoplastic sheeting. Foil can also be coated with thermoplastic synthetic-resin coatings which are not only heat sealing, but offer substantial protection against mildly corrosive products and environments.

By the use of quick-drying "metal" inks, foil can be printed on directly for the purpose of labeling and decoration. Printing can also be done over lacquer coatings or plastic films laminated to foil. The nonsorptive character of the foil requires the use of inks specially developed for this type of application.

The second article in this series next month will show how aluminum foil and foil laminates can be employed efficiently in bags, cartons and other type containers.

References

1. "Measuring Permeability to Carbon Dioxide and Water Vapor," J. D. Edwards and D. B. Strahm, Morgan Packaging 19 (Oct., 1943).
2. "Bibliography on the Hygienic Aspects of Aluminum and Aluminum Utensils," G. D. Beal, et al., Bulletin No. 3, Mellon Institute of Industrial Research, Pittsburgh, 1933.

Cosmetic foresight

(*Continued from page 109*) volved the adoption of the basic package design to price lists, letterheads, counter and window displays, so that starting in April, 1917, the new integrated program was ready to show to the trade. In introducing the line, HQZ replaced all existing inventory of old merchandise with an equal value for the new. "This was extremely well received by dealers," said Mr. Conwell, "still lacerated and bruised by the kicking around they got during the war.

"It was a Herculean job, but very soon the effect began to show on the ledgers. June, July, August, September and October figures surpassed corresponding months in 1915 and 1916 by from 10 to 45%," he stated. "Distribution is expanding, profits are growing. Definitely, HQZ has reversed its trend by taking drastic action when drastic action was needed."

CREDITS: *Designer, Norman Slewer, San Francisco. Labels, Mercury Press, San Francisco. Closures, manufactured by Armstrong Cork Co., Lancaster, Ohio, and supplied by I. F. Schnier Co., Inc., San Francisco. Bottles, Owens-Illinois Glass Co., San Francisco. Displays, Kobrand Co., San Francisco.*

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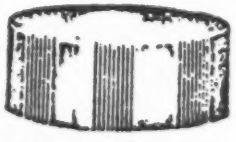

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Foreword

The fabrication of VINYLITE resins into new forms regularly creates new problems in the cementing of these resins to themselves, and to a variety of other materials. In recent years, a number of efficient solution adhesives have been developed, and these are now available for commercial use. These cements will answer the need for a satisfactory bonding material in a great many applications, although their use will not solve all bonding problems.

The bonding problem is complicated by the fact that there are a number of types of VINYLITE resins available. These may be formulated in different ways, and such formulations can be used to bond an extremely wide variety of materials, such as aluminum, glass, bronze, wood, cement, and many others.

This booklet includes, first of all, a summary of the generally used methods of bonding VINYLITE resin compounds. Detailed suggestions for standard combinations follow. This information can be used as a basis for study and experimentation whenever unusual bonding problems are encountered. If the reader is faced with a bonding problem not covered by this information, or which cannot be solved with commercial VINYLITE resin adhesives, the Plastics Division of Carbide and Carbon Chemicals Corporation will be pleased to offer suggestions.

The Bonding of VINYLITE Resins

The very properties which make VINYLITE resins so valuable to industry, namely, chemical inertness, toughness, and insolubility, make it difficult to bond these resin compounds to themselves and to other materials. Chemical inertness, associated with high intermolecular forces, is an indication of the incompatibility of the vinyl resins with other materials. Two incompatible materials are held together by comparatively weak forces which are, in general, insufficient to bond an incompatible resin to the plastic material. This sharply limits the number of materials which may serve as a base for an adhesive for use with VINYLITE resins. Only a few incompatible resins have been used successfully to modify the properties of other resins which are compatible with the vinyl resin.

The low solubility of the vinyl resins mitigates against solvent welding, accomplished so readily with the more soluble resins, such as the cellulose esters. Despite this fact, there are laminating thinners which can be used in solvent welding plasticized sheeting to itself.

In a brief outline of the subject of bonding VINYLITE resins it is patently impossible to cover all of the variety of conditions which might be encountered. In fact, nearly every cementing job is unique. Inasmuch as the success or failure of the bonding is often of major importance in the application of VINYLITE resins, it is well to study the particulars involved so that these general facts can be used in solving individual bonding problems.

Bonding Methods

There are four general methods of bonding VINYLITE plastics. These are: 1. the use of one of the solvents which has a solvating effect on the resin; 2. the use of a cement prepared by dissolving a resin in a solvent; 3. the use of certain of the pressure-sensitive adhesives; and 4. the use of heat-sealing operations.

Detailed suggestions for bonding vinyl resins will be included in the later discussion, but, first, it would be well to consider the bonding methods in general.

1. SOLVENT BONDING

There are several good solvents generally referred to as laminating thinners, which will soften adjacent plastic surfaces to such an extent that they will adhere. These solvents, in effect, serve as a cold welding method of joining two plastic surfaces. The bond formed by this method has considerable strength immediately after application. The ultimate strength of the bond is reached as soon as the solvent evaporates. The strength of the joint, when these bonds are properly prepared, is practically as high as that of the original plastic. Careful attention to the details of application is necessary to insure the success of this bonding method.

2. SOLUTION ADHESIVES

A bond can be formed by the use of a resin compound dissolved in a solvent. In use, the solution forms a bond with each of the surfaces being joined, and thus the success of the method depends upon the holding power of the solution itself. These adhesives set very slowly, and have little strength immediately after application. The strength of the bond increases slowly as the solvent evaporates.

3. PRESSURE-SENSITIVE ADHESIVES

Pressure-sensitive adhesives, typified by rubber cements are used in a great many industrial operations because of their high initial strength, and the wide latitude allowable in bonding time. This type of cement depends upon the tackiness of a solvent-free film to adhere the surfaces. Tackiness is usually obtained through the use of plasticizers or soft resins in the compound. The initial bond strength is generally the highest strength that will be achieved unless the adhesive film is vulcanized.

4. HEAT-SEALING

The fourth method is one which has gained prominence as a production method comparatively recently. It is the joining of the plastic surfaces by pressing together areas softened by heat, or by a combination of heat and solvent. This is, in effect, welding the surfaces together. The strength of the bond immediately after sealing is dependent upon the temperature of the surfaces. As soon as the sheets have cooled to room temperature, the strength of the bond will be practically as high as that of the original plastic. Automatic sealing machines which utilize heat to achieve the bond have been developed by several companies for their own use. Commercial machines are still being perfected. These machines develop temperatures ranging from 200 to 500 deg. F. They operate on much the same principal as a seam welder, or a production sewing machine. The temperature, the speed of bonding, and the pressure applied are adjusted to the thickness of the plastic and to the compound used.

Adhesive Materials

Some of the materials used in these methods of bonding VINYLITE plastics are discussed in the following:

Solvents: The ketones are the most powerful solvents that have been discovered for vinyl chloride-acetate resins. The cyclic ketones form solutions with the highest solids content, but they evaporate rather slowly, and, in general, are used only for grade VYNW resins. Mixtures of ketones and aromatic hydrocarbons have a faster solvent action than do the ketones alone. Propylene oxide is also extremely valuable in speeding the solution of VINYLITE resins, and it increases the bite of the solvents into the plastic surfaces, particularly those based upon grade VYNW resin. Adequate ventilation should be employed where solvents are used.

Resins: The vinyl chloride-acetate resins, Grades VYNW, VYNS, VYHH, and VMCH, can all be used in adhesives. Resin VYNW requires the strongest solvents, forms solutions of low solids content and longest drying time, but yields films of the greatest flexibility, fatigue life, and resistance to change with temperature. Because of its better solubility characteristics, resin VYNS is widely used as an adhesive for VYNW sheeting, but adhesives made with this resin are inferior to VYNW adhesives in fatigue life and temperature range. Resin VYHH is used only when a reduction in adhesive strength can be tolerated and where adhesives must have a high solids content, and so a resin of greater solubility than VYNS is required. These adhesives cannot be used where fatigue life and flexing are the most important considerations. Resin VMCH has much the same properties as the VYHH resin, but it also has the property of releasing solvents more rapidly. Moreover, it is the only vinyl chloride-acetate resin which adheres to nonporous surfaces without baking. For this reason,

has been widely used in adhesive formulations. The vinyl chloride-acetate resins used in adhesives do not develop a high degree of tackiness either in solution or in a film wet with solvent or plasticizer. This limitation can be overcome to some extent by incorporating in the vinyl resin adhesive certain resins such as the acrylic and methacrylic ester resins, rosin, rosin esters and coumorone resins. These resins are compatible with vinyl chloride-acetate resins and adhere to VINYLITE resin surfaces. For this reason they are used in other types of adhesives to improve their adhesion to VINYLITE plastics. A list of such compatible resins is given in Table 1. These soft adhesive resins are seldom used alone as adhesives for flexible VINYLITE sheeting because most of the plasticizers used in the sheeting soften these resins to a greater extent than they do the VINYLITE resin. As a result a coating of one of these resins in contact with VINYLITE plasticized sheet will soften progressively as long as contact is maintained. This softening is minimized when the resin adhesive contains the less soluble VINYLITE resins.

Table I

Resins Compatible with VINYLITE Resin VYNS

Acrylic and Methacrylic Types:	Supplier, See Key on Page 16
ACRYLOID A-10	18
ACRYLOID B-7	18
ACRYLOID B-72	18
ACRYLOID B-75	18
ACRYLOID F-10	18
Ethyl Methacrylate Polymer	8
n-Propyl Methacrylate Polymer	8
Methyl Methacrylate Polymer	8
n-Butyl Methacrylate Polymer	8
Isobutyl Methacrylate Polymer	8

Acrylic and methacrylic resins increase the wet strength of adhesives. Butyl methacrylate resins lower softening point of VINYLITE resin adhesives.

Synthetic Rubber:	
HYCAR OR-15	13
HYCAR OR-25	13

HYCAR plasticizes and softens VINYLITE resin. It requires 20 to 30 minutes' milling on a differential rubber mill before dissolving.

Gum and Rosin Derivatives:	
Ester Gum	2
Wood Rosin	11
Hydrogenated Rosin and Derivatives	11

Gum and rosin derivatives impart tackiness to adhesives, but the wet strength is not usually very great. On drying, the adhesive may tend to be brittle.

Sulfonamid-Formaldehyde Resins	Suppliers, See Key on Page 16
SANTOLITE Resins MS and MHP	14
Phenolics:	
BAKELITE RESIN BR-254	4
BR-2987	4
XR-3180	4
XR-3360	4
XR-4357	4
DUREZ 550	9
Coumarone-Indene Resins:	
CUMAR P-10	1
CUMAR P-25	1
Alkyds:	
DURAPLEX A-25	18
DURAPLEX C-45	18
GLYPTAL 2451	10
GLYPTAL 2454	10
REZYL 110	2
PETREX 7, 21, and 22	11
Chlorinated Resins:	
Chlorinated diphenyls	7, 14
Chlorinated paraffins	4, 11, 12
Chlorinated rubber (slightly incompatible)	11
Natural Resins:	
Accroides	—
Elemi	—

Pressure-Sensitive Adhesives: Adhesives of this type which are based on natural rubber do not adhere well to VINYLITE plastics. However, the Buna N types of synthetic rubber, particularly Hycar OR, are compatible, and yield excellent adhesives for many purposes. Details of the formulation of these adhesives can be obtained from the sales literature of Hycar Chemical Company. Even better adhesion to VINYLITE plastics, and higher strength, can be obtained by blending vinyl chloride-acetate resins with the synthetic rubber. Tackiness is also promoted by the use of Cumar resins, or by the addition of plasticizers. The film should be vulcanized after the coated surfaces have been united in order to eliminate the tackiness and to achieve maximum strength of the bond.

Fast acting accelerators, such as Butyl 8, are required for low temperature vulcanization with most Hycar base adhesives, while Altax, Captax, and similar types of accelerators yield good results where the bonded surfaces can be heated. Vulcanization of these solution adhesives will take place slowly even at room temperature. Therefore, such self-vulcanizing adhesives should be formulated in two portions, and these two portions mixed together shortly before using. The vulcanization accelerator, and a portion of the elastomer are put into solution in one part of this cement. The major portion of the elastomer, and all other compounding ingredients, including specifically the sulfur, and zinc oxide, are dispersed in the second part of the cement.

Hycar OR, and VINYLITE VYNS resin can be used together to formulate a pressure-sensitive adhesive which does not require an accelerator. Such adhesives can also be classified under the second method of bonding noted in the foregoing, as tackiness is secured through solvent retention, and solvent evaporation is all that is necessary to obtain a bond.

Plasticized Sheet and Sheeting

BONDING TO PLASTICIZED SHEETING

A rapid and strong bond for joining plasticized sheeting to itself is obtained in many instances through the use of solvents. No heat, and very little pressure, is required to effect this bond. A balanced and active solvent mixture found extremely useful is XT-5033 shown in Table II. It is necessary to add a word of caution concerning the effect of the sheet composition on the bond obtained, since radically different results are obtained with different compositions. For example, the presence of certain waxes in the sheeting often prevents the establishment of strong bonds.

There are a few instances where the use of solution cements in preference to solvents alone has proved advantageous. In these instances, solutions of VYNS or VYNW in XT-5033 have been recommended. For example, when the bond formed between two sheets must sustain a small force immediately after the surfaces are joined, cement XL-5174, Table III, a solution of resin VYNW in XT-5033, has been used successfully. This adhesive is also valuable when a short time must elapse between the application of the adhesive, and establishment of the bond. A similar adhesive, XL-5173, a solution of VYNS with higher solids content, has been used when cloth or other decorative materials are to be laminated between VINYLITE resin surfaces.

In still another type of application, a solution of VYNW in XT-5033 at 12 to 15 per cent solids is used. Since a solution of this concentration forms a gel on standing at room temperature, it must be prepared and used warm (that is, 95 to 115 deg. F.). Such a hot solution applied to plasticized sheeting can be used to form a strong, immediate bond, such as required when sheeting is to be bonded under tension.

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Table II
Laminating Thinners

	XT-5015	XT-5020	XT-5021	XT-5033	Supplier, See Key Page 16
	Part by Weight				
Kronisol	5	2.5	2.5		16
Methyl Acetate (82 per cent)	58				5
Ethyl Acetate (85 per cent)	10				5
Butyl Acetate	10				5
Methyl Ethyl Ketone		63		40	5
Dioxane		20			5
Isophorone		2.5	2.5		5
Methylene Dichloride			50		8
Ethylene Dichloride			43		5
Cyclohexanone				40	1
Propylene Oxide				20	5
Trioluoil	15				3
Acetic Acid	2	2.0	2.0		—
Methanol		10			5
	100	100	100	100	

Formulation Notes:

The acetic acid is added as a wetting agent.

The plasticizer (Kronisol) improves the bond in the faster acting thinners, especially where moisture might be condensed on the sheet due to evaporation of the solvent. It is possible that the plasticizer also minimizes embrittlement, but, in general, it should be eliminated in thinners containing high boiling-point solvents.

Propylene oxide is one of the speediest penetrants known for vinyl chloride-acetate resins, and this solvent improves the "bite" into the material when used up to 20 to 25 per cent of the thinner. It should not be used with acetic acid. If propylene oxide evaporates too rapidly, acetone may be used as a substitute. Since propylene oxide is extremely volatile, boiling at 95 deg. F., care should be taken in storage of the adhesives which include this solvent in order to prevent its evaporation.

The chlorinated hydrocarbons are excellent solvents for VINYLITE resin, and well suited for use in laminating thinners. The toxic hazards involved in the use of these solvents mitigate against their use except where excellent ventilation is provided. These solvents present less of a fire hazard than do other types of solvents, but the odors of the chemicals are objectionable to many people.

Cyclohexanone and isophorone are extremely high-boiling solvents which contribute slow drying and long tack life to adhesives. Used alone, they are very slow penetrants, and are, therefore, preferably diluted with low-boiling solvents. The other ketones, acetone, methyl ethyl ketone, methyl isobutyl ketone, are excellent solvents.

The esters are weak solvents for VYNS resin, but they appear to be released somewhat faster and more completely than ketones. The commercial esters are usually mixtures of the pure ester and the corresponding alcohol. The presence of the alcohol aids in preventing the excessive softening of the VINYLITE resin sheet. The fact that ethyl acetate, butyl acetate, and amyl acetate are important components of fingernail lacquers makes their odors familiar, and therefore more acceptable to women workers. For this reason, when it is necessary to have a solvent stronger than XT-5015, it is often desirable to modify this thinner by replacing all or part of the Trioluoil with a ketone of appropriate evaporation rate retaining the esters.

Sheeting has also been bonded to itself successfully through the use of pressure-sensitive Vyvar adhesives discussed on page 8, and detailed in Table IV.

Heat-sealing methods similar to those noted on page 6 are also used successfully in joining plasticized sheeting. Faster and easier sealing at lower platen temperatures may be accomplished if the surfaces are first wet with a solvent such as XT-5033. Many unique products such as desalinating kits, bags for treating burns with liquid, gun covers and others, are fabricated in this manner.

BONDING TO METAL AND CERAMIC SURFACES

The bonding of plasticized sheeting to metal and similar non-porous surfaces can be accomplished by several systems. In this field, commercial adhesives* are of special value. The bonding systems often require the application of a VINYLITE resin primer to the surface to which the plasticized sheeting is to be cemented. A VMCH resin solution, such as XL-5252, Table VI, or a pigmented variation of this cement, may be applied to the metal surface in a light coat.

Table III
Solution Adhesives

	XL-5129	XL-5151	XL-5170	XL-5171	XL-5173	XL-5174	XL-5181	XL-5221	Supplier, See Key Page 16
	Parts by Weight								
Resin VYNS	10		12		20			2	5
Resin VYNW						10			5
Poly-n-butyl-methacrylate	10	32	12	20					8
Rosin			6						11
Chlorinated rubber 1000 cp							25.0		11
Plasticizer E-60							12.5		12
Methyl ethyl ketone	80		70	70	32	36	62.5	96	5
Cyclohexanone					32	36			1
Propylene Oxide					16	18			5
Toluol		34							3
Solvesso No. 2		34							19
Petrex No. 21				10					11
Acetic Acid								2	
	100	100	100	100	100	100	100.0	100	

*A list of manufacturers of available commercial adhesives will be sent on request.

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Table IV

HYCAR Base Adhesives

	XL-5199	XL-5238	XL-5256	Suppliers, See Key, Page 16
	Parts by Weight			
Resin VMCH	10.0		10.0	5
Hycar OR-15	10.0	13.0	10.0	13
Cumar P-25		4.3		1
Dioctyl Phthalate		4.3		5
Nitroethane		12.9	7.5	6
Methyl Ethyl Ketone	80.0	65.0	16.1	5
Ethyl Acetate			16.0	5
Methyl Isobutyl Ketone			20.0	17
Toluene			20.0	—
Sulfur		0.3	0.2	—
Captax		0.2	0.2	20
	100.0	100.0	100.0	

Air drying for 24 hours is desirable, but a short bree dry at 200 to 225 deg. F. is equally satisfac- ory. A VYHH, or VYNS resin primer can be sed, but these solutions require baking at 350 to 75 deg. F., and are somewhat limited in their usefulness since they may lose their adhesion to the metal in the presence of an excess of active Vinylite resin solvent. Formula XE-90, Table VI, is typical of a baking primer, but other Vinylite resin coatings are equally applicable.

Table V

Emulsion Adhesive

	XL-5213	Supplier, See Key, Page 16
	Parts by Weight	
125c.p. Chlorinated Rubber	25.4	11
Chlorinated Paraffin (60 per cent of chlorine)	12.7	11, 12
Toluene	41.3	—
Sodium Oleate	1.0	2
Water	19.6	—
	100.0	

Note: Add water and soap to the chlorinated rubber – chlorinated paraffin solution with rapid agitation.

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Table VI

Adhesive Primers

	XL-5123*	XL-5220	XL-5252	XE-90	Supplier, See Key, Page 16
	Parts by Weight				
Resin XYNC	10				5
Resin VMCH		4.75	28		5
Resin VYNS		4.75			5
Resin VYHH				14.80	5
Santicizer B-16			6		14
Kronisol				2.72	16
Methanol	30				5
Dioxane	60				5
Methyl Ethyl Ketone		24.80	20		5
Methyl Isobutyl Ketone		31.00	20	29.20	5
Isophorone		3.30			5
Propylene Oxide			1		5
Methyl Amyl Ketone				7.30	5
Toluene		28.10	25	29.20	–
Xylene		3.30		7.30	–
Blue Lead				9.48	–
	100	100.00	100	100.00	

*Prolonged breathing of the solvent vapors should be especially avoided.

Where a wide range of bonding times are desired, a pressure-sensitive adhesive of the Hycar type, such as XL-5238, Table IV, is recommended. Where a shorter tack life is permissible, the VMCH type adhesive, XL-5252, has proved useful. This is applied to both surfaces and dried to a satisfactory tack, after which the surfaces are faced and held together under pressure. For quicker bonding, the surfaces are coated with XL-5252, permitted to dry, then the solvent is reactivated just before bonding.

In some instances, heat, or heat and pressure, can be used in the bonding process. An adhesive, such as XL-5129, Table III, applied to the sheet is advisable since this cement has a lower bonding temperature than the resin. The coated sheeting can be pressed on to a metal surface, previously coated with XE-90, Table VI, after the metal has been heated to 325 to 375 deg. F. Little pressure is required to achieve the bond. When this process can be completed quickly, sheeting under some tension can be bonded successfully.

Sometimes, where stress will not be imposed on the bond, a temporary or pressure-sensitive adhesive, such as XL-5171, Table III, or Goodyear Cement No. AF 12C, will give adequate bond strength to non-porous surfaces.

BONDING TO LEATHER

Several types of adhesives have been used for bonding plasticized sheeting to leather. Resin

VMCH, or VYNS adhesives adhere readily to the leather surface, and will unite the plasticized sheeting to leather if the surfaces are faced while the adhesive is still tacky. Somewhat better tack is obtained if softening resins and plasticizers are added to the adhesive. Typical examples of such formulations are XL-5129, and XL-5170, Table III. Adhesives containing mixtures of VINYLITE resins and Hycar OR also are valuable in bonding VINYLITE resins to leather. This type can be used under a wide variety of conditions. The cement, XL-5199, Table IV, is an example of a simple air-dry type, while XL-5256 is a typical vulcanizing type.

BONDING TO WOOD

A variety of adhesives is available for use on wood, including commercial types, and the choice depends largely on the conditions required for the bonding and the surface of the wood to be joined. The strongest bonds have been established with two-coat systems since the adhesives which bond best to plasticized sheeting are not particularly well suited for use on wood. There are several good wood primers available. These may be based on resin XYNC, VINYLSEAL adhesive MA 28-18 or pyroxylin-vinyl acetate. The primed wood is then bonded to the sheeting with a solution containing one of the acrylate resins, such as Acryloid A-10, or B-7, or a chlorinated rubber adhesive such as formula XL-5181, Table III. When cement XL-5181, or XL-5180, are used as single coat adhesives, somewhat weaker bonds are obtained. Cement XL-5180 has the advantage of quicker tack.

These adhesives for wood were developed to provide a tacky surface suitable for bonding under a wide variety of conditions. Where it is necessary to bond sheeting under tension, and into sharp depressions, it is often advisable to use some type of heated tool to heat the sheet and to bond through plastic flow.

BONDING TO CONCRETE, WALLBOARD, AND SIMILAR MATERIALS

Concrete, or a similar surface, should be primed with a VYHH, or VMCH lacquer, before bonding. The sheeting can then be cemented to this surface while the lacquer is still tacky. A preferable method is to bond the plasticized sheeting to the dried primer through the use of a VYNS-Hycar adhesive. When the concrete or plaster surface is quite rough, the use of a heavy-filled primer is advisable.

BONDING TO CLOTH

The choice of an adhesive for bonding plasticized sheeting to cloth depends largely upon the fabrication method preferred. One of the most satisfactory methods involves the priming of the cloth with a VYNW, or a VYNS solution, drying, and then bonding the cloth and sheeting under heat and pressure. Typical cloth primers would be:

	A	B	Suppliers, See Key, Page 16
	Parts by Weight		
Resin VYNS	18		5
Resin VMCH	2		5
Resin VYNW		14	5
FLEXOL DOP	18	5.5	5
Methyl ethyl ketone	25	40.5	5
Cyclohexanone		40	1
Hexone	23		5
SOLVESSO No. 1	14		19
	100	100	

Penetration of the coating into the cloth will improve adhesion, but it will also lower the flexibility of the combination. Therefore, some variation in solvent and plasticizer contents of these coatings will have to be made to fit individual requirements and coating conditions. The VYNW coating would be preferred where the coating must withstand extremes of temperature.

The plasticized sheeting can also be bonded to the cloth through the use of heat and pressure, or a solution adhesive can be used. Priming VINYLITE resin sheet surface with XL-5129,

Table III, lowers the temperature requirement for bonding, but, likewise, it lowers the high temperature bond strength.

In other instances, rather strong bonds can be obtained if a heavy solution of a VINYLITE resin adhesive is applied to the cloth, and the sheeting bonded to this while the adhesive is still wet with solvent. Heating at 180 to 250 deg. F. to remove the solvent is desirable in order to obtain a strong bond.

BONDING TO RUBBER E49

Only in a few exceptional cases have adequate bonds of VINYLITE resins to soft rubber been obtained. In these instances, a Goodyear cement No. AF 12C, was used. It is probable that in some cases a multiple coat system, using a rubber compatible synthetic as a primer, with increasing quantities of Buna N rubber in the subsequent coats, will bond VINYLITE plastic to rubber.

Bonding Thin Films

Thin films of VINYLITE plasticized resin can be bonded to themselves and to other materials simply and quickly through the use of heat and moderate pressure. In some instances, when adhering films to paper or textiles, a strong bond can be achieved by pressing the film against the surface to be bonded with a hot laundry iron or photographic hot press. Heat-sealing of the films to themselves can be accomplished with similar equipment designed for continuous production processes. In some instances, it is advantageous to achieve initial adhesion by first softening a portion of the area with solvent, and facing the sheets in position.

Bonding Molded and Extruded Products

The success of the bonding of molded and extruded products to sheeting, to themselves, or to other materials, will depend on the surfaces available for adhesion. The smaller the available area, the less chance there is to secure an adequate bond. Procedures to be followed are largely dependent on individual conditions. The bonding methods to be used are the same as those recommended for similar types of plasticized resins.

Bonding Coated Cloth To Coated Cloth

Cloth with a relatively thin coating of VINYLITE resin can be bonded to itself successfully through the use of various heat-sealing methods. When the cloth has a heavier coating, the use of a solution adhesive is recommended. One such adhesive which has been used successfully with cloth coated with VYNS and VYNW resins is XE-5127-1, shown in Table VII. It is suggested that this adhesive be prepared in the following manner: Mill Hycar 20 to 30 minutes; add pigments and filler; add sulfur last; mill an additional 3 to 5 minutes; soak stock in nitroethane for at least one hour; follow with mixing of the solution, and the addition of dioctyl phthalate

...l Cumar, thin the heavy paste with remaining ...lvent while agitating thoroughly; add Captax ...m freshly prepared 10 per cent methyl ethyl ...tone solution the same day adhesive is to be ...ed. If it is desirable to prepare the adhesive ...nsiderably in advance of use, it is advisable to ...ke a two-part adhesive solution with the sul...r, zinc oxide, and part of the Hycar in one ...tion, and the Captax in the second part. These ...rts are then mixed just prior to use.

In the event that the shortage of Hycar makes it impossible to formulate adhesive XE-5127-1, the solution adhesive shown with this cement in Table VII can be employed. In preparing this adhesive, the BAKELITE resin, XR-9396, is heated to 100 to 150 deg. C., and poured into cold isophorone. The solution is then stirred until it is clear and uniform. Then propylene oxide is added, and finally, the VYNS resin is stirred in. The viscosity of the finished product can be adjusted by varying the amount of propylene oxide. This adhesive has good wet strength, fair tack

Table VII

Adhesives For VINYLITE Resin Coated Cloth

	XE-5127-1	"Dewey and Almy" HYCAR Replacement*	XL-5246	Supplier, See Key, Page 16
	Parts by Weight			
...sin VYNS		7.14		5
...sin XYHL (dry)			9	5
...AKELITE Resin XR-9396		7.14		4
...AKELITE Resin XV-16530			50	4
...YCAR OR	15.2			13
...AKELITE Hydrogenerated Rosin			18	11
...UMAR P-25	4.9			1
...hiting	15.15			—
...on Oxide Black	3.6			—
...on Oxide Yellow	3.6			—
...nc Oxide	3.6			—
...ioctyl Phthalate	4.9		18	5, 16
...itroethane	18.9			6
...ethyl Ethyl Ketone	14.9			5
...hyl Acetate, 95 per cent	14.9			5
...ophorone		14.29		5
...opylene Oxide		71.43		5
...cetone			5	5
...lfur	0.35			—
	100.00	100.00	100	

*...ake ... before using.

lite, adheres well to both cloth and vinyl chloride-acetate resin coatings, and gives an adequately strong bond. If cloth coated with vinyl butyral resin is to be bonded, cement XL-5246, Table VII, is recommended. Again, the presence of certain waxes or lubricants in the coating compound often prevents the establishment of a strong bond.

Bonding Coated Paper To Coated Paper

In practically all cases, coated paper is bonded to itself through the use of heat and moderate pressure, although laminating thinners may be used with equal success. Conditions of the operation are dependent upon the type of paper used, and formulation of the coating.

Variations May Be Necessary

The procedures discussed in the foregoing, and the formulations given, are believed to be adequate for practically all bonding of VINYLITE plastics to themselves, and to other materials. A number of excellent solution adhesives are available on the industrial market, and a list of such adhesive manufacturers will be sent on request. Nevertheless, the extreme range of materials to be bonded, and the infinite variety of conditions to be overcome makes it highly probable that the procedures and formulations will have to be modified in some instances to meet specific conditions. This is especially true in regard to the solvents used in the formulations. Such modification is an individual problem, and can be solved only through experimentation. It is recommended that the bonding procedures be tested thoroughly to be certain of their adequacy in production operations before entering into large-scale use.

SUPPLIERS OF CHEMICALS AND RESINS

1. Allied Chemical & Dye Corporation, Barrett Division, 61 Broadway, New York, N. Y.
2. American Cyanamid Company, 30 Rockefeller Plaza, New York, N. Y.
3. Anderson-Prichard Oil Corporation, Oklahoma City, Oklahoma.
4. Bakelite Corporation, 30 East 42nd Street, New York, N. Y.
5. Carbide and Carbon Chemicals Corporation, 30 East 42nd Street, New York, N. Y.
6. Commercial Solvents Corporation, 17 East 42nd Street, New York, N. Y.
7. Dow Chemical Company, 919 Jefferson Avenue, Midland, Michigan.
8. E. I. DuPont DeNemours & Company, Inc., Wilmington, Delaware.
9. Durez Plastics & Chemicals, Inc., 1911 Walck Road, North Tonawanda, N. Y.
10. General Electric Company, 111 Plastics Avenue, Pittsfield, Massachusetts.
11. Hercules Powder Company, Inc., 908 Market Street, Wilmington, Delaware.
12. Hooker Electrochemical Company, 1940 Ward Street, Niagara Falls, N. Y.
13. Hycar Chemical Company, Akron, Ohio.
14. Monsanto Chemical Company, 1700 So. Second Street, St. Louis, Missouri.
15. The Neville Company, 1938 Neville Island, Pittsburgh, Pa.
16. Ohio-Apex, Inc., Nitro, West Virginia.
17. Pittsburgh Plate Glass Company, 2222 Grant Building, Pittsburgh, Pennsylvania.
18. The Resinous Products & Chemical Company, Inc., 222 W. Washington Square, Philadelphia, Pennsylvania.
19. Standard Oil Company of New Jersey, 26 Broadway, New York, N. Y.
20. R. T. Vanderbilt Company, Inc., 943 Gene Street, East Norwalk, Connecticut.

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Aug. 3, 1954 G. F. NADEAU ET AL 2,685,511

METAL REINFORCED CELLULOSE ESTER PHOTOLITHOGRAPHIC PRINTING PLATES

Filed May 3, 1952

Fig. 1

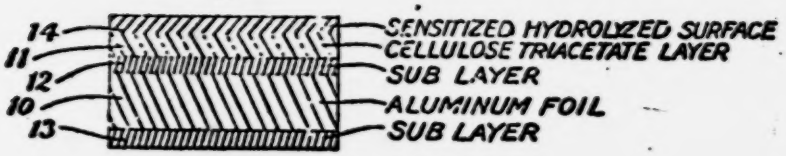


Fig. 2

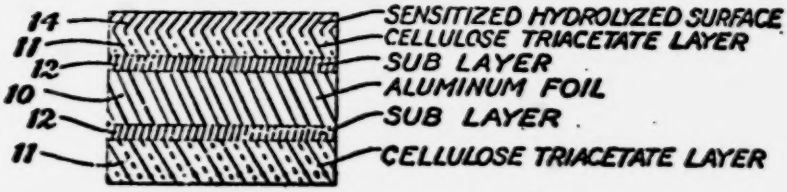


Fig. 3

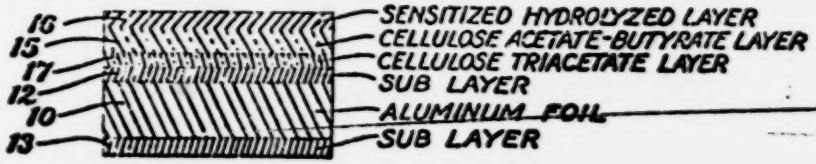
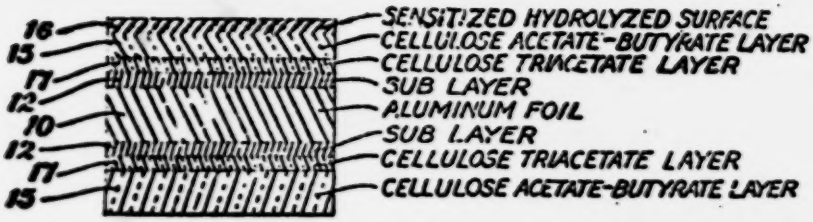


Fig. 4



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Patented Aug. 3, 1954

2,685,511

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UNITED STATES PATENT OFFICE

2,685,511

METAL REINFORCED CELLULOSE ESTER PHOTOLITHOGRAPHIC PRINTING PLATES

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Application May 3, 1952, Serial No. 285,934

12 Claims. (Cl. 95—8)

1

This invention relates to the preparation of an improved light-sensitive photographic element and more particularly to such element protected against halation and free from dimensional and chemical instability and especially designed for use in making lithographic printing plates.

This application is a continuation-in-part of our copending application Serial No. 173,378, filed July 12, 1950, now Patent No. 2,635,962 of April 21, 1953.

Printing plates of the photolithographic type are well known having been prepared previously, for example, from metal plates carrying light-sensitive colloid layers and from cellulose ester plates carrying similar light-sensitive stratum or layer. R. S. Colt, in United States Patent 2,448,851, dated September 7, 1948, describes a method for preparing cellulose ester type printing plates according to which a surface hydrolyzed cellulose ester sheet is sensitized with a bichromate such as potassium bichromate, and after exposure under a design, the exposed area is removed with aqueous solutions of chlorites or hypochlorites such as, for example, sodium hypochlorite, thereby producing ink-receptive areas in the region of the exposure and ink-repellant areas, when moistened, in the region of the unexposed areas. It is highly desirable in a process of the above kind to include an antihalation layer and, following the usual practice in the art, it might appear that the antihalation layer coated on the rear surface of the sensitive plate would provide adequate protection from halation effects. However, it has been found that when such elements are subjected to alkaline hydrolysis by immersion methods to produce a stratum of hydrolyzed cellulose ester on the surface of the plate, the dye later tends to be removed in the process leaving the residual dye in uneven and mottled condition, as well as contaminating the hydrolysis bath with dyestuff. Another disadvantage of such elements is that while satisfactory as a printing plate for short runs, on continued running they tend to stretch and pull out from clamps of the type used on many small offset printing presses. Accordingly, such elements have been found to lack dimensional and chemical stability for precision registration on long continued runs.

While reinforcing materials such as thin metal foils have been proposed heretofore for reinforcing various cellulose ester photographic elements, all attempts to produce a highly satisfactory type of surface hydrolyzed and sensitized cellulose ester printing plate provided with a thin metal foil reinforcement have failed for one reason or another. For example, when thin metal foil is

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used as the reinforcing material, the usual binding pastes or cements tend to break down and allow the cellulose ester coat or sheet to pull away from the metal foil at the edges of the composite plate, especially when the composite element or plate is subjected to the action of aqueous caustic solutions in the step of forming the surface hydrolyzed layer or surface on the cellulose ester coating or sheet. Subsequent treatment by various processing solutions and by prolonged use of the finished printing plate in contact with printing inks caused a similar distortion or peeling at the edges of the plate. Where the reinforcing metal foil is a desirable metal such as zinc or aluminum, the aqueous caustic hydrolyzing solution vigorously attacks and corrodes such metal foils. Protective coatings or backings commonly employed to protect metal surfaces, when applied to the exposed back surface of the metal foil of the above type of composite plate have been found impractical to use or ineffective in that the bonding of the metal to the cellulose ester or to the protective coating or backing does not hold as firmly as desired, or in that the protective coating or backing is etched or dissolved away under the hydrolyzing action of the caustic solution.

We have now found that excellent light-sensitive photographic elements designed for preparing lithographic printing plates, and especially elements which are protected against halation effects and intimately bonded to reinforcing metal foil, and which have none of the aforementioned disadvantages of dimensional instability and adverse susceptibility to processing solutions, can be prepared as described hereinafter.

It is, accordingly, an object of our invention to provide light-sensitive elements having dimensional and chemical stability, and more particularly such elements protected against halation, for use in making lithographic printing plates. A further object is to provide lithographic printing plates having dimensional and chemical stability. Another object is to provide novel processes for preparing such photographic elements and printing plates. Other objects will become apparent hereinafter.

In the accompanying illustrative drawings Figs. 1–4, Fig. 1 is an enlarged, diagrammatic cross-sectional view of a light-sensitive photographic element comprising a thin aluminum foil having an outer layer on one side of cellulose triacetate.

Fig. 2 is similar to Fig. 1 but denotes an aluminum foil having outer layers on both sides of cellulose triacetate.

Fig. 3 is similar to Fig. 1 but differs therefrom

in that the aluminum foil has an outer layer on one side of cellulose acetate-butyrate.

Fig. 4 is similar to Fig. 3, but differs therefrom in that the aluminum foil has outer layers on both sides of cellulose acetate-butyrate.

In accordance with our invention, we prepare our new light-sensitive photographic elements of the surface hydrolyzed and sensitized cellulose organic acid ester type in a number of modifications, wherein the reinforcing material is a metal foil of from 0.002–0.005-inch thickness, depending on what type and thickness of element is desired. One form of the invention comprises an element having an overall thickness of approximately 0.006-inch and is prepared by bonding a coated layer from a solution or dope of a cellulose organic acid ester preferably containing an antihalation dye incorporated therein to a metal foil such as zinc, aluminum, etc., preferably aluminum foil, by means of an interlayer or sublayer coated on the foil comprising a resinous, thermoplastic material, the other side of the foil being protected against the hydrolyzing and processing solutions by a similar layer of a resinous, thermoplastic material coated thereon, curing the coated foil and subjecting it to a hydrolyzing bath, followed by sensitization of the resulting hydrolyzed outer surface of the cellulose organic ester layer with a suitable sensitizing agent. Another form of the invention having an overall thickness of approximately 0.005-inch and particularly free from curl is prepared as above, but the cellulose organic acid ester in solution or dope form is applied as a coating to both sides of the subbed metal foil and at least one of the resulting outer surfaces is hydrolyzed and sensitized. Mixtures of one or more cellulose organic esters can be used. A particularly valuable element is one wherein the hydrolyzed and sensitized outside layer is a cellulose acetate-butyrate. When this kind of layer is subjected to hydrolysis, sensitized, exposed under a pattern and developed, the small halftone dots obtained are much stronger and show greater resistance to removal by swabbing action with aqueous caustic during processing than is the case with elements wherein the outer layer is some other cellulose organic acid ester such as, for example, cellulose triacetate. However, the cellulose acetate-butyrate shows relatively poor adhesion to the subbing layer. Consequently, to obtain a good quality element having an outer surface of cellulose acetate-butyrate, the metal foil is first subbed as before, then coated with a solution of a different cellulose organic acid ester to give a relatively thin layer of the ester, preferably cellulose triacetate, and then overcoated with a relatively thicker layer of a solution of cellulose acetate-butyrate preferably containing the antihalation dye. In this kind of composite element a layer of cellulose acetate-butyrate can be used for the hydrolyzed and sensitized surface or stratum and the other side of the foil can be a layer of any of the other cellulose organic acid esters, for example, a layer of cellulose triacetate. The subbing, coating and hydrolysis processes lend themselves readily to continuous form of operations.

Suitable cellulose organic acid esters which we employ for preparing the above-described products of our invention are substantially fully esterified esters including cellulose acetate having the maximum resistance to moisture and containing about 43.5% by weight of acetyl groups, and other esters of equivalent acyl content such as cellulose propionate, cellulose butyrate, cellulose acetate-propionate, cellulose acetate-butyrate, etc. The preferred outer surface is cellulose acetate-butyrate wherein the proportions of acetyl to butyryl can vary over a wide range, for example, 6% Bu. and 38% acetyl to 20% Bu. and 29% acetyl but preferably we use cellulose acetate-butyrates containing 17.5% Bu. and 30% acetyl. As previously mentioned the cellulose organic esters are applied in solution or dope form in one or more volatile solvents such as methylene chloride, ethylene dichloride, acetone, mixtures of these with up to about 20% by weight of one or more lower alcohols such as ethanol, methanol, etc. The solutions or dopes intended for coating an outer surface of approximately 0.001-inch thickness are adjusted to a concentration sufficient for this purpose which depends upon the characteristics of the particular cellulose ester, but generally a concentration of from 6–12% has been found efficacious. The antihalation dye is incorporated in such solutions. Where cellulose acetate-butyrate is used as the outer layer to be hydrolyzed and sensitized, the intermediate cellulose triacetate solution functions as a cement between the subbed metal foil and the layer of cellulose acetate-butyrate, and is made up in similar solvents in concentrations of about from 0.5–2% by weight of cellulose triacetate. The thickness of this intermediate layer in dried condition does not ordinarily exceed 0.0001-inch, although much thicker layers can be used, if desired.

In the hydrolysis step, the outer cellulose ester surface of the composite reinforced foil is hydrolyzed on the surface to the predetermined depth always leaving a stratum of unhydrolyzed material. This is accomplished by simply immersing the cellulose ester coated metal foil for a few minutes in an aqueous alcoholic solution of a caustic alkali (e. g. sodium hydroxide, potassium hydroxide, lithium hydroxide, etc.), followed by washing the hydrolyzed product with water, neutralizing residual alkali with weak acid solution such as 1–5% aqueous acetic acid. In the case where cellulose ester coatings are made to both sides of the metal foil, if desired, only one side need be hydrolyzed by simply applying the hydrolyzing solution to this side as by swabbing action, and the like. The concentration of the hydrolyzing solution can be varied to some extent, depending on the time of exposure, the temperature of the bath and the degree of hydrolysis desired. A suitable solution is 5% sodium hydroxide in equal parts of ethyl alcohol and water, which gives good hydrolyzing results at 70° C. in about 3–5 minutes exposure. By operating at 60° F., the time required is somewhat longer, whereas at 100° F. the required time is considerably shorter and more critical.

The subbing solutions which give sublayers having satisfactory adhesion to metal foils, particularly to aluminum foil, and to layers of cellulose organic acid esters coated from the aforementioned solutions or dopes, particularly to layers of cellulose triacetate coated from such solutions, are the subbing solutions prepared with interpolymers of various mixtures of vinyl chloride and vinyl acetate which contain a small proportion of free carboxylic acid groups. A suitable subbing solution consists of 6% by weight of a ternary interpolymer containing approximately 86% by weight of vinyl chloride groups, 13% by weight of vinyl acetate groups and 1% by weight of α,β-unsaturated dicarboxylic acid

groups such as maleic or fumaric acid groups, 45% by weight of butyl acetate and 45% by weight of methylene chloride. In place of methylene chloride, other solvents in admixture with each other or with methylene chloride can be employed such as acetone, 1,4-dioxane, ethylene dichloride, etc. The concentration of the interpolymer in solution can be varied from about 1–10%, but preferably an approximately 6% solution of the above interpolymer or of generally similar interpolymers can be employed.

The antihalation dye employed in the process of our invention is selected from those which absorb in the blue and ultraviolet regions of the spectrum, and which are compatible with the cellulose organic acid ester solutions used for providing the coated layer of cellulose ester over the subbed metal foil. The preferred dye (or mixture of dyes) is used in a concentration of about 0.5–3%, although considerable variation is possible.

Suitable sensitizers include compounds which like bichromate (e. g. ammonium bichromate, sodium bichromate, potassium bichromate, etc.) will quickly oxidize hydrolyzed cellulose organic acid esters, in the presence of blue or ultraviolet light transmitted by a design such as a line or half-tone negative, to an alkali-soluble state, and include other sensitizing compounds such as ferric ammonium oxalate, which can be used in conjunction with a ferricyanide (e. g. potassium ferricyanide, etc.) and which is reducible to ferrous salt images in the presence of light, but which does not oxidize cellulose in the presence of light, so that is necessary in this case to use alkaline oxidizing solutions such as hydrogen peroxide in dilute aqueous alkali metal hydroxide (e. g. sodium hydroxide, potassium hydroxide, etc.) to effect removal of the hydrolyzed cellulose ester in the exposed area. For a detailed description of suitable sensitizers and subsequent development of the relief images, reference can be had to Kenyon and Unruh, U. S. Patent 2,548,537, dated April 10, 1951.

The following examples and cross-sectional drawings will serve to illustrate further our new halation-free and dimensionally and chemically stable, light-sensitive, photographic elements, and the manner for preparing the same.

Example 1

A light-sensitive photographic element designed for preparing a lithographic printing plate of approximately 0.006-inch thickness was prepared by first subbing an aluminum foil of 0.0045-inch thickness on both sides with a solution consisting of 6% of an interpolymeric resin containing 86% by weight of vinyl chloride groups, 13% by weight of vinyl acetate groups and 1% by weight of dibasic acid groups such as maleic or fumaric acid groups, in methylene chloride, drying the sublayer, and then coating a layer of cellulose acetate solution over one of the subbed surfaces of the aluminum foil in such manner that there results an aluminum foil having on one side a firmly bonded layer of cellulose acetate of approximately 0.0015-inch thickness. The solution employed for coating the aluminum foil consisted by weight of 8% of cellulose triacetate, 50% of methylene chloride, 7% of isopropyl alcohol and 5% of ethylene chloride. An antihalation dye which absorbs light in the blue region of the spectrum such as Cesar [illegible] in J. B. Dickey, U. S. Patent 2,264,303, dated December 2, 1941, particularly p-nitrobenzene-azo-3-hydroxyethyl-o-chloroaniline, was incorporated in the cellulose acetate coating solution or dope in an amount equivalent to 1% based on the weight of the solution. After curing the subbed and coated foil, it was surface hydrolyzed on the side having the outer cellulose triacetate coating by passing the coated foil through 5% sodium hydroxide dissolved in equal parts of ethyl alcohol and water, the hydrolyzing time being approximately 3 minutes at a bath temperature of 70° F. The hydrolyzed coated foil was then passed through an acid stop bath consisting of 2% acetic acid in water, washed with fresh water and dried. By this treatment there was obtained a hydrolyzed stratum of cellulose triacetate of a thickness on the order of one micron. By varying the hydrolytic conditions, the thickness of the hydrolyzed stratum can be varied to about half thickness or increased to twice or even three times the above figure. The hydrolyzed composite foil produced as described remained perfectly flat, showed no tendency to peel, the antihalation dye in the unaffected part of the cellulose triacetate layer remained of even shades, and the sandwiched-in-aluminum foil was entirely unaffected by the hydrolysis treatment. In the case where the subbing solution is applied only to the side of the foil which is to be coated with the cellulose triacetate solution, then prior to the hydrolysis step the other face of the foil must be coated with a thin coating of resinous protective material such as the subbing solution to protect the metal from the etching action of the caustic hydrolyzing bath.

The hydrolyzed composite foil was then sensitized by treating the hydrolyzed surface with an aqueous solution of ammonium bichromate under non-actinic light conditions, and the sensitized composite foil dried. The light-sensitive photographic element thus obtained was then exposed under a suitable design such as a line or half-tone negative to actinic light, and developed to a relief image by lightly swabbing the exposed surface with a 2% aqueous caustic soda solution. The brown image which had formed on exposure soon disappeared and the hydrolyzed cellulose triacetate was gradually removed from the exposed area. Following neutralization of the excess alkali with 2% aqueous acetic acid solution, it was found that the exposed and developed areas readily received greasy printing inks, whereas the areas containing unexposed hydrolyzed cellulose triacetate, when moistened, repelled such inks. The dried product thus obtained was free from dimensional distortions and weaknesses and gave excellent results as a printing plate over an extended period of operation in a press. Other of the mentioned sensitizers can be used in the above example in place of the ammonium bichromate.

The light-sensitive photographic element prepared as described in the above example is shown in cross-section in Fig. 1, wherein the cellulose triacetate layer 11 having an outer sensitized hydrolyzed stratum 14 and an antihalation dye incorporated therein, is firmly bonded as shown to a thin aluminum foil 10 by means of a thin layer 12 of subbing compound which acts as an adhesive, and wherein the other side of the foil is protected with a layer 13 of the subbing compound or some other equivalent resin material which is unaffected by the caustic hydrolyzing bath.

Example 2

A light-sensitive photographic element designed

for preparing a lithographic printing plate of approximately 0.006-inch thickness was prepared by first subbing an aluminum foil of 0.003-inch thickness on both sides with a solution consisting of 6% of an interpolymeric resin containing 86% by weight of vinyl chloride, 13% by weight of vinyl acetate and 1% by weight of dibasic acid groups such as maleic or fumaric acid groups, in methylene chloride, drying the subbed foil and then overcoating it with a cellulose triacetate solution in such manner that there resulted an aluminum foil having on each side firmly bonded thereto a layer of cellulose triacetate of approximately 0.0015-inch thickness. The coating solution consisted by weight of 8% of cellulose triacetate, 80% of methylene chloride, 7% of isopropyl alcohol and 5% of ethylene chloride. An antihalation dye which absorbed light in the blue region of the spectrum such as described by J. B. Dickey, U. S. Patent 2,264,303, dated December 2, 1941, particularly p-nitrobenzene-azo-p-hydroxyethyl-o-chloroaniline, was incorporated in the cellulose triacetate coating solution in an amount equivalent to 1% based on the weight of the dope. After curing the double coated aluminum foil, it was subjected to hydrolysis by swabbing one of the coated surfaces with aqueous alcoholic caustic solution, followed by sensitization with ammonium bichromate, etc. following the procedure described in Example 1. The sensitized photographic element so produced was exposed through a suitable design to actinic light and the relief image developed. Excellent results were obtained with this printing plate on long extended operation in a printing press.

The light-sensitive photographic element prepared as described in the above Example 2 is shown in cross-section in Fig. 2, wherein cellulose triacetate layer 11 having an antihalation dye incorporated therein and having an outer hydrolyzed sensitized stratum 14, is firmly bonded as shown to a thin aluminum foil 13 by means of a thin layer 12 of subbing compound which acts as an adhesive, and wherein the other side of the foil is similarly bonded by means of the subbing compound 12 to a layer of cellulose triacetate 11 which may or may not contain an antihalation dye.

Example 3

A light-sensitive photographic element designed for preparing a lithographic printing plate of approximately 0.006-inch thickness was prepared by first subbing an aluminum foil of 0.0045-inch thickness both sides with a solution consisting of 6% of an interpolymeric resin containing 86% by weight of vinyl chloride groups, 13% by weight of vinyl acetate groups and 1% by weight of dibasic acid groups such as maleic or fumaric acid groups, in methylene chloride, drying the sub layer, then coating a thin layer of 1.5% solution of cellulose triacetate in methylene chloride over one of the subbed surfaces of the aluminum foil, drying the coated foil, and then overcoating the layer of cellulose triacetate with an 8% solution of cellulose acetate-butyrate (containing 30% acetyl groups and 17.5% butyryl groups) in a 90:10 mixture of ethylene dichloride and methyl alcohol, and containing 0.15% of triphenyl phosphate as a plasticizer, 0.75% of an orange dye, p-nitrobenzeneazo-p-hydroxyethyl-o-chloroaniline and 1.0% of a yellow dye such as o-nitro-p-chlorobenzeneazo-5,5-dimethyl-1,3-cyclohexadione, based on the weight of cellulose acetate-butyrate, in such manner that the dried layer of cellulose acetate-butyrate had approximately 0.001-inch thickness. After curing the double coated foil, the outer cellulose acetate-butyrate surface was hydrolyzed by passing the composite foil through 5% sodium hydroxide dissolved in equal parts of ethyl alcohol and water, the hydrolyzing time being approximately 3 minutes at a bath temperature of 70° F. The hydrolyzed foil was then passed through an acid stop bath consisting of 2% aqueous acetic acid, washed with fresh water and dried. By this treatment there was obtained a hydrolyzed stratum of cellulose acetate-butyrate on the order of one micron. By varying the hydrolytic conditions, the thickness of the hydrolyzed stratum can be varied to about half thickness or increased to twice or even three times the above figure. The hydrolyzed composite foil produced as described remained perfectly flat, showed no tendency to peel, the antihalation dyes in the unaffected part of the cellulose acetate-butyrate layer remained of even shades, and the sandwiched-in-aluminum foil was entirely unaffected by the hydrolysis treatment. In the case where the subbing solution is applied only to the side of the foil which is to be coated with the cellulose organic acid ester, then prior to the hydrolysis step the other face of the foil must be coated with a thin coating of resinous protective material such as the subbing solution to protect the metal from being etched by the caustic hydrolyzing bath.

The hydrolyzed composite foil was then sensitized by treating the hydrolyzed surface with an aqueous solution of ammonium bichromate under non-actinic light conditions and the sensitized composite foil dried. The light-sensitive photographic element thus obtained was then exposed under a suitable design such as a line or half-tone negative to actinic light, and developed to a relief image by lightly swabbing the exposed surface with a 2% aqueous caustic soda solution. The brown image which had formed on exposure soon disappeared and the hydrolyzed cellulose acetate-butyrate was gradually removed from the exposed area. The elevated portions of the relief image (unexposed areas) were more sharply defined and stronger than similar reliefs produced as described in Example 1. Following neutralization of the excess alkali with 2% aqueous acetic acid solution, it was found that the exposed and developed areas readily received greasy printing inks, whereas the areas containing unexposed hydrolyzed cellulose acetate-butyrate, when moistened, repelled such inks. The lithographic plate so produced was free from dimensional distortions and weaknesses even after long periods of operation, and its printing face gave superior printings and had much longer useful life period of operation than was found with similar plates having printing faces produced with other of the mentioned cellulose organic acid esters such as, for example, with cellulose triacetate printing faces.

The light-sensitive photographic element prepared as described in the above example is shown in cross-section in Fig. 3, wherein the cellulose acetate-butyrate layer 15 having an outer sensitized hydrolyzed stratum 16 and an antihalation dye incorporated therein, is firmly bonded as shown to a thin layer of cellulose triacetate 17 and this latter layer is in turn bonded firmly to a thin aluminum foil 10 by means of a thin layer 12 of subbing compound, and wherein the other side of the aluminum foil is protected with a layer 13 of

the subbing compound or some other equivalent resin material which is unaffected by the caustic hydrolyzing bath.

Example 6

A light-sensitive photographic element designed for preparing a lithographic printing plate of approximately 0.006-inch thickness was prepared by first subbing an aluminum foil of 0.003-inch thickness on both sides with a solution consisting of 6% of an interpolymeric resin containing 86% by weight of vinyl chloride, 13% by weight of vinyl acetate and 1% by weight of dibasic acid groups such as maleic or fumaric acid groups, in methylene chloride, drying the subbed foil and then coating a thin layer of 1.5% solution of cellulose triacetate in methylene chloride over both of the subbed surfaces, drying the coated foil, and then overcoating this layer of cellulose triacetate on each side of the foil with an 8% solution of cellulose acetate-butyrate (containing 30% acetyl groups and 17.5% butyryl groups) in a 90:10 mixture of ethylene dichloride and methyl alcohol, and containing 15% of triphenyl phosphate, 0.75% of an orange dye, p-nitrobenzeneazo-β-hydroxyethyl-o-chloroaniline, and 1.0% of a yellow dye, o-nitro-p-chlorobenzeneazo-5,5-dimethyl-1,3-cyclohexadione, based on the weight of the cellulose acetate-butyrate, in such manner that each of the dried layers of cellulose acetate-butyrate had a thickness of approximately 0.001-inch. After curing, one of these surfaces was then hydrolyzed, sensitized, exposed, developed and dried as described in Example 3. The printing plate so produced had similarly good properties as that described in Example 3.

The light-sensitive photographic element prepared as described in above Example 4, is shown in cross-section in Fig. 4, wherein cellulose acetate-butyrate layer 15 having an antihalation dye incorporated therein and having an outer hydrolyzed sensitized stratum 16, is firmly bonded as shown to a thin layer of cellulose triacetate 11 and this latter layer is in turn bonded firmly to a thin aluminum foil 10 by means of a thin layer 12 of subbing compound, and wherein the other side of the aluminum foil is similarly attached by means of thin layers 12 and 17 to cellulose acetate-butyrate layer 15 which may or may not contain an antihalation dye.

By proceeding as shown in the foregoing examples, other operable light-sensitive photographic elements can be prepared, for example, by replacing the outer layers of cellulose triacetate and cellulose acetate-butyrate with layers of cellulose propionate, cellulose butyrate or cellulose acetate-propionate. For some purposes it may be desirable to hydrolyze and sensitize both outer surfaces of elements such as those of Examples 2 and 4. The elements wherein cellulose acetate-butyrate is employed as the outer layer need not have the antihalation dye incorporated in the cellulose acetate-butyrate layer, since it is also practical to incorporate such antihalation dyes in the intermediate cellulose triacetate layer. However, the antihalation dye can also be incorporated in the sub layer of any of the light-sensitive photographic elements of our invention. Although the invention has been illustrated in all of the examples with elements containing an antihalation dye in one or more layers on the light sensitive side of the element, it will be understood that elements of more limited application which contain no antihalation dye in any of the layers are also included in our invention.

The coating technique employed for preparing the light-sensitive photographic elements of the invention is according to well-established procedures for obtaining flat, smooth, bubble-free layers of the material to be coated. Generally, the solution or dope is coated at or slightly above room temperature and then cured at elevated temperatures, but substantially below the boiling point of the solvent. The actual coatings can be accomplished by immersion, by coating from a hopper with a coating knife arrangement, by extrusion or spraying methods.

What we claim is:

1. A light-sensitive photographic element comprising a metal foil and a coated layer of cellulose organic acid ester bonded together with an interlayer comprising a resinous interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid adherent thereto, the said cellulose organic acid ester layer having a hydrolyzed stratum on its outer surface sensitized with an agent selected from the class consisting of oxidants for cellulose in the presence of light and light-reducible ferric salts incapable of oxidation of cellulose to the alkali-soluble state in the presence of light, and the said aluminum foil having the outer surface thereof covered with a layer of the said resinous interpolymer.

2. A light-sensitive photographic element comprising a metal foil and a coated layer of cellulose organic acid ester bonded together with an interlayer comprising a resinous interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid adherent thereto, and wherein at least one of said layers on the light-sensitive side of the foil contains an antihalation dye, the said cellulose organic acid ester layer having a hydrolyzed stratum on its outer surface sensitized with an agent selected from the class consisting of oxidants for cellulose in the presence of light and light-reducible ferric salts incapable of oxidation of cellulose to the alkali-soluble state in the presence of light, and the said aluminum foil having the outer surface thereof covered with a layer of the said resinous interpolymer.

3. A light-sensitive photographic element comprising an aluminum foil and a coated layer of cellulose triacetate bonded together with an interlayer comprising a resinous interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid adherent thereto, the said cellulose triacetate layer containing an antihalation dye incorporated therein and having a hydrolyzed stratum on its outer surface sensitized with an agent selected from the class consisting of oxidants for cellulose in the presence of light and light-reducible ferric salts incapable of oxidation of cellulose to the alkali-soluble state in the presence of light, and the said aluminum foil having the outer surface thereof covered with a layer of the said resinous interpolymer.

4. A light-sensitive photographic element comprising an aluminum foil and a coated layer of cellulose triacetate bonded together with an interlayer comprising a resinous interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid adherent thereto, the said cellulose organic acid ester layer containing an antihalation dye incorporated therein and having a hydrolyzed stratum on its outer surface sensitized with an agent selected from the class consisting of oxidants for cellulose

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in the presence of light and light-reducible ferric salts incapable of oxidation of cellulose to the alkali-soluble state in the presence of light, and the said aluminum foil having the outer surface thereof covered with a composite layer of the said resinous interpolymer adjacent to the foil and a layer of the said cellulose triacetate adhered thereover.

5. A light-sensitive photographic element comprising an aluminum foil and a coated layer of cellulose acetate-butyrate bonded together with one interlayer adjacent to the foil comprising a resinous interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid and a second interlayer comprising cellulose triacetate adjacent to the layer of cellulose acetate-butyrate, the said cellulose acetate-butyrate layer containing an antihalation dye incorporated therein and having a hydrolyzed stratum on its outer surface sensitized with an agent selected from the class consisting of oxidants for cellulose in the presence of light and light-reducible ferric salts incapable of oxidation to the alkali-soluble state in the presence of light, and the said aluminum foil having the outer surface thereof covered with a layer comprising the said resinous interpolymer.

6. A light-sensitive photographic element comprising an aluminum foil and a coated layer of cellulose acetate-butyrate bonded together with one interlayer adjacent to the foil comprising a resinous interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid and a second interlayer comprising cellulose triacetate adjacent to the layer of cellulose acetate-butyrate, the said cellulose acetate-butyrate layer containing an antihalation dye incorporated therein and having a hydrolyzed stratum on its outer surface sensitized with an agent selected from the class consisting of oxidants for cellulose in the presence of light and light-reducible ferric salts incapable of oxidation to the alkali-soluble state in the presence of light, and the said aluminum foil having the outer surface thereof covered with a thin layer of the said resinous interpolymer adjacent to the foil and a layer of the said cellulose acetate-butyrate adhered thereover.

7. A method for preparing a photographic element which comprises subcoating both sides of a metal foil with a composition comprising an interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid, then coating at least one side of said subcoated foil with a composition comprising cellulose organic acid ester and hydrolyzing the outer stratum of at least one of said coatings of cellulose organic acid ester.

8. A method for preparing a photographic element which comprises subcoating both sides of an aluminum foil with a composition comprising an interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic

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acid, then coating one side of said subcoated foil with a composition comprising cellulose triacetate and an antihalation dye, and hydrolyzing an outer stratum of the said overcoating of cellulose triacetate.

9. A method for preparing a photographic element which comprises subcoating both sides of an aluminum foil with a composition comprising an interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid, then coating both sides of said subcoated foil with a composition comprising cellulose triacetate and an antihalation dye, and hydrolyzing an outer stratum of at least one of said coatings of cellulose triacetate.

10. A method for preparing a photographic element which comprises subcoating both sides of an aluminum foil with a composition comprising an interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid, then coating one side of said subcoated foil with a composition comprising cellulose triacetate, and then overcoating the layer of cellulose triacetate with a composition comprising cellulose acetate-butyrate and an antihalation dye, and hydrolyzing an outer stratum of the said cellulose acetate-butyrate.

11. A method for preparing a photographic element which comprises subcoating both sides of an aluminum foil with a composition comprising an interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid, then coating both sides of said subcoated foil with a composition comprising cellulose triacetate, and then overcoating both the layers of cellulose triacetate with a composition comprising cellulose acetate-butyrate and an antihalation dye, and hydrolyzing an outer stratum of at least one of said layers of cellulose acetate-butyrate.

12. A method of preparing a photographic element which comprises subcoating both sides of an aluminum foil with a composition comprising an antihalation dye and an interpolymer of vinyl chloride, vinyl acetate and an α,β-ethylenically unsaturated dicarboxylic acid, then coating at least one side of the subcoated foil with a composition comprising cellulose organic acid ester and hydrolyzing the outer stratum of at least one of said coatings of cellulose organic acid ester.

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SUPREME COURT, U. S.

Supreme Court, U.S.
FILED
MAY 21 1974
MICHAEL RODAK, JR., C

IN THE

Supreme Court of the United States

October Term, 1973

No. 73-1590

DYNEX INDUSTRIAL PLASTICS CORP.,

Petitioner,

v.

ANCHOR PLASTICS COMPANY, INC.,

Respondent.

RESPONDENT'S BRIEF OPPOSING PETITION FOR WRIT OF CERTIORARI

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May 22, 1974

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Argument

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ABBREVIATIONS USED IN THIS BRIEF

Pet. p. —	Petition
Pet. Appx. — p. —a	Appendix to Petition
PX	Plaintiff Respondent's Trial Exhibit
DX	Defendant Petitioner's Trial Exhibit
App. —a	Joint Appendix, Volumes 1-5, containing pleading and trial testimony in appeal before Court of Appeals
App. E —	Two Joint Appendix Volumes containing exhibits in appeal before Court of Appeals

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ll emphasis in this brief is ours, unless otherwise noted.

IN THE

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DYNEX INDUSTRIAL PLASTICS CORP.,

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RESPONDENT'S BRIEF OPPOSING PETITION FOR WRIT OF CERTIORARI

The petition presents no sound reason why the writ should be granted.

There is no conflict between decisions of Courts of Appeals. There is no Federal question which has been decided in a way in conflict with any decision of this Court. Further, there has been no departure from the accepted and usual course of judicial proceedings. The case involves no significant constitutional question nor issue of substantial public interest.

This case is a routine action for patent infringement in which the patent has been held to be valid and infringed. The questions presented by petitioner Dynex are limited to validity and involve matters thoroughly considered by the District Court and adequately reviewed by the Court of Appeals.

The decisions below are right, and there is no sound reason why this Court should grant the Writ.

Additional review by this Court is of importance solely to the litigants and presents no substantial public question justifying exercise of certiorari jurisdiction.

Opinions Below

The opinion of the District Court for the District of New Jersey is reported at 363 F. Supp. 582 and is printed in Petitioner's Appendix A at page 1a.

The *per curiam* judgment order of the Court of Appeals for the Third Circuit affirming the judgment of the District Court is unreported but is printed in Petitioner's Appendix C at page 54a.

The *en banc* decision of the Court of Appeals denying rehearing is unreported but is printed in Petitioner's Appendix D at page 56a.

Questions Presented

Substantially none of the "Questions Presented" in the petition, pages 2-3, fairly arise in the instant record, and none whatsoever can be reached without reversing a substantial number of fact findings correctly made below.

Statutes Involved

The pertinent statutes are portions of the Patent Laws, Title 35 U.S.C. §§101, 102, 103 and 112 and are set forth in Petitioner's Appendix E at page 57a.

Restatement of the Case

Petitioner's statement of the case is inaccurate and incomplete. The facts are:

1. The Essential Nature of the Case

The patent in suit is U.S. Patent No. 3,136,676 dated June 9, 1964. It was issued to Richard Fisch (the inventor) and is assigned to Anchor Plastics Company, Inc., the respondent herein.

The patent in suit relates to thermoplastic extruding. In "thermoplastic" extruding, solid pellets of thermoplastic are fed into a hot extruder where they are melted into a formless mass. This molten thermoplastic mass then is forced by the extruder screw through a die. As the hot, melted thermoplastic emerges from the die it has the shape

of the cross-section of the die opening (App. 90a-96a). This extruded thermoplastic is immediately quenched by water to harden and set the thermoplastic in the new shape formed by the die (App. 90a-96a).

This quenching suddenly reduces the temperature of the extrusion about 300 degrees Fahrenheit (App. 99a-103a, 155a-158a).

The patent in suit describes and claims a process for extruding thermoplastic products with at least one visible region having a metallic appearance (PX-1; Appx. F, 64a).

A shiny and glossy appearance is attained by extruding a transparent thermoplastic about a metal foil, such as aluminum. The process produces a relatively inexpensive and attractive decorative trim that can be substituted for all brass or all aluminum products. The plastic product of the patented process costs only two cents or so a foot.

The all metal product costs two to four times as much (App. 226a).

Strips extruded by the process of the patent in suit are in widespread use as decorative trim on automobiles, home appliances and radio and television cabinets (App. 224a, 225a, 421a and 422a).

2. The Problem of Wrinkling and Distortion

Before the invention of the patent, such extruded products often had substantial defects. The "foil wrinkled so as to give the effect of an inferior product" (PX-1; Pet. Appx. F, p. 64a, col. 1, ll. 24-5).

The prior art thermoplastic extrusion process produced foil trim with wrinkling to such a severe degree that plaintiff's business therein came substantially to a halt in 1955 (App. 221a).

For a year and a half, employees of respondent, Anchor, tried without success to solve the problem (Pet. Appx. A, 4a, 32a, 33a). Respondent tried:

(a) Quenching with hot water, rather than cold water, to relieve the strains and distortions set up by cold water quenching (App. 112a-113a).

(b) Flame treating the metal foil to burn off residue on the foil and heat the foil to a temperature more compatible to the thermoplastic (App. 113a).

(c) Changing the extruding temperature to lower the viscosity of the thermoplastic so that the thermoplastic might flow around the foil and be softer (App. 114a).

(d) Annealed foil was used (App. 114a).

(e) The surface of the foil was roughened with a wire brush in an attempt to form a mechanical bond between the thermoplastic and the foil (App. 426a).

Attempts in the opposite direction by providing *slippage* to relieve strains between the metal foil and the thermoplastic material were also tried and failed:

(a) Applying a lubricant to the foil (App. 111a-112a).

(b) Using two foils, in face-to-face contact so that the foils might slip on each other (App. 114a-115a).

3. The Performance Achievement of the Invention

Finally, it was discovered by Richard A. Fisch, the inventor in the patent in suit, that by first applying a thin coating of one of four particular thermoplastic lacquers* to at least one surface of the metal foil and then extruding a transparent thermoplastic about the lacquer coated foil the problems of foil wrinkling and distortion were eliminated.

As soon as the invention was made in 1957, complaints from Anchor customers that the foil was wrinkling and distorting and the products were discoloring were no longer received (App. 127a-130a, 214a-216a, 223a).

The use of the process by respondent, Anchor, has been highly successful. From 1957 to the date of trial, Anchor's sales of products extruded with the Fisch process were over 3 million dollars and were still increasing (App. 223a-224a).

The patent in suit is licensed to General Motors Corporation, Glass Laboratories and Macoid Industries Inc. (Pet. Appx. A, p. 40a).

4. The Patent Claims Are to a Process

Claims 1, 2 and 3 of the patent in suit are directed to a *process.* (Petition p. 6, footnote 3).

The first step comprises providing a metal foil having a thin, film-like coating on at least one of its surfaces of

* "The foil 21-5 is coated with a thin layer of adhesive lacquer 26-5 which may have a base of cellulose butyrate, cellulose nitrate, ethyl cellulose, polyvinyl acetate-polyvinyl chloride" (PX-1; Pet. Appx. F, 65a, col. 1).

a transparent thermoplastic lacquer of one of four particular types, i.e., cellulose nitrate, cellulose butyrate, ethyl cellulose, and polyvinyl acetate-polyvinyl chloride lacquers.

The second step comprises extruding a transparent thermoplastic material about the lacquer coated foil while feeding the foil in unison with the thermoplastic material.

5. The Trial Below

The trial in the District Court lasted seven days and included courtroom demonstrations and presentation of exhibits in the fields of thermoplastic extrusion, infra-red spectroscopy and others (e.g. App. 90a-96a, 102a, 115a-119a, 121a-126a, 131a-132a, 140a-143a, 180a-184a, 611a-614a, 669a, 669a-783a, 761a-774a). Five witnesses testified and were extensively cross-examined. Three were experts.

The Trial Court's opinion (Pet. Appx. A, pp. 1a-51a) consists of forty-four pages and includes detailed findings of scientific fact. The opinion rests, in important part, on the credibility of witnesses. The Trial Court found that:

> "it was surprising and amazing that a strong bond was formed under the conditions of the patented process. * * * 'it is very amazing and surprising that after bending the product made by the patented process no wrinkling occurs.'" (Pet. Appx. A, p. 31a)

ARGUMENT

I

The first question presented by the petition, and the first reason asserted for granting the writ, raise routine fact questions of interest only to the litigants; they were rightly decided by the courts below.

A. The first question presented and first reason asserted for granting the writ assert matters of no general importance.

At page 2 and pages 10-14, the petition asserts that the Fisch process was not a patentable invention under the obviousness statute, 35 U.S.C. 103. This is the question raised by infringers in virtually all patent cases.

Petitioner's argument turns on the facts, which it has stated inaccurately and incompletely.

The petition asserts that the decision below conflicts with this Court's decision in *Sinclair & Carroll Co., Inc.* v. *Chemical Corp.*, 325 U.S. 327 (1945). This is incorrect. As we show *infra*, the courts below did nothing contrary to the *Sinclair* decision.

B. The courts below rightly decided the question of 35 U.S.C. 103 patentability.

The main attack of the petition on the Fisch invention as "obvious" under 35 U.S.C. 103 is premised on a straw-man argument using incorrect facts.

The premise is that the Fisch invention of the patent in suit solved a problem in the context of a product that

came apart. Because the product came apart, the petition argues, it was obvious to select a commercially available adhesive lacquer on the foil to keep the parts glued together (Pet. p. 11). This is incorrect. The Trial Court found:

> "The problem was not simply how to prevent wrinkling or delamination in a product but, instead, how to prevent it by a manufacturing process occurring in an environment of a high speed hot melt extrusion process, inside an extruder having the temperature of an oven, followed by a suddenly tremendous drop in temperature of over 300 degrees." (Pet. Appx. A, p. 31a)

The Trial Court considered and rejected Dynex's simplistic, hindsight argument in no uncertain terms:

> "Fundamental to defendant's prior art argument is its statement, with which I shall now deal, that the wrinkling problem met by the Fisch invention was actually a problem of delamination in which the aluminum foil and the transparent thermoplastic material came apart after completion of the extrusion process. Accordingly, to adhere these elements better to each other, defendant argues, it was obvious to use an adhesive to glue them together; and defendant sees this as so clearly indicated that it makes the contention initially even without specific prior art support." (Pet. Appx. A, p. 29a).

The Trial Court found, as a scientific fact, that wrinkling "is caused by factors during extrusion and is not synonymous with delamination" (Pet. Appx. A, p. 44a).

These findings are fully supported by the evidence. Witness Rothman demonstrated to the court that wrinkling and distortion of foil occurs *during* the extrusion process and without bending and delamination. An extruded prod-

uct showing such wrinkling and distortion caused during the prior art extrusion process was put into evidence as Court Exhibit 2 (App. 183a-184a).

This exhibit shows that "delamination" or "separation" is an extreme case and is not synonymous, at all times, with wrinkling and distortion. This is consistent with the admission of defendant's own expert witness, Dr. Skeist. He admitted that cigarette paper foil wrinkled when flexed even though there was perfect gluing (without separation) between the paper and aluminum foil (App. 646a). This physical exhibit (cigarette paper foil) is in evidence as PX-27 (App. 656a).

The evidence of Professor Bruins (App. 248a) also supports the Trial Court's finding that the problem was not wrinkling or delamination in a *product* that came apart but how to prevent wrinkling in a thermoplastic extrusion *process.*

The Trial Court correctly recognized that the "obvious" adhesive argument was simplistic hindsight. The Trial Court stated (Pet. Appx. A, p. 30a):

> "The simplicity inherent in hindsight is often misleading."

The Trial Court noted that the very material used in the hot melt extrusion process was itself an adhesive. The wrinkling and distortion problem occurred despite the fact that the transparent thermoplastic materials most commonly used were cellulose acetate or cellulose acetate butyrate (App. 433a-434a). These materials themselves have adhesive qualities or tendencies (App. 638a-639a).

Since the transparent thermoplastic material itself was adhesive, it was not obvious or even logical to use still another adhesive to glue it to metal foil. Why use glue B to adhere glue A to metal foil?

As the Trial Court stated:

> "Defendant's argument overlooks that the thermoplastic material used in the extrusion process itself had adhesive tendencies. It is understandable why one skilled in the art might not find it obvious to use in addition an adhesive to resolve the wrinkling problem." (Pet. Appx. A, p. 30a).

The petition ignores almost all of the physical exhibits and scientific evidence fully supporting the critical fact findings of the Trial Court. Those findings are clearly right. Petitioner's "obvious adhesive" argument has no merit.

C. No conflict with the *Sinclair* decision

Petitioner mistakenly relies upon *Sinclair & Carroll Co., Inc.* v. *Interchemical Corp.*, 325 U.S. 327 (1945). There, the patentee had developed a rapidly drying printing ink by merely selecting, from a list of solvents, a solvent known to have a desired boiling point. The solvent had no functional relationship to the printing ink involved. The invention was obvious.

Here, however, the four Fisch lacquers do have a functional relationship to the heart of the process. Inside the extruder, they mingle and blend into the molten thermoplastic mass and coact with it (App. 244a-245a).

Moreover, one cannot pick out the four Fisch lacquers from the commercial lacquers available without hindsight knowledge of the invention. They have no particular desired boiling point or other peculiar physical characteristic that distinguishes them from the thousands of other adhesive lacquers available. For example, the prior art *Alcoa* booklet lists "methacrylates, chlorinated rubbers and rubber polymers" (Pet. Appx. H, p. 81a) and "starch, casein, casein latex, sodium silicate, glucose and resin emulsions, to thermoplastics in organic solvents, waxes, asphalts and various formulated blends of these materials", "blends with gums and dextrines", "resins, plasticizers", "synthetic or reclaimed rubber", "asphalt, waxes", etc. (Pet. Appx. H, p. 82a).

The petition also relies (pp. 11, 12) on testimony of witness Bruins where he said it would be "obvious to try" various adhesives, including those named in the patent.

This testimony resulted from hindsight loaded questions. Professor Bruins was asked (App. 329a) whether there was any reason why one "could *not* use" in the process of the prior art Shanok patent (DX-Q, Pet. Appx. G, p. 69a) the particular *Fisch named adhesives* among the many in the prior art Alcoa article (DX-X, Pet. Appx. H, p. 70a). Once you know Mr. Fisch's answer to the wrinkling problem, it is true there is no reason why one could *not* try those four as well as all the many other adhesives of the Alcoa article in the process of the Shanok patent. Why not? Dr. Bruins was asked a second time whether one "would at least try" the four adhesives. Dr. Bruins correctly answered that one would try "as evidenced by the Fisch patent" (App. 329a).

However, the controlling statute, 35 U.S.C. 103, requires that the test of obviousness of an invention be made "at the time the invention was made". The statute is not concerned with hindsight.

Here, the Trial Court correctly found that, without hindsight, a skilled person would be confronted in the prior art not just with the four lacquers of the patent in suit but with hundreds, if not thousands, of adhesives that are not differentiated from the four Fisch lacquers:

> "Defendant's simplistic approach also omits to mention that the process in suit explicitly refers to specific lacquers; and it is clear that there is no statement in any prior art that these four specifically referred to lacquers would solve the wrinkling problem. The skilled person in the pertinent art would be confronted by hundreds, if not thousands, of adhesives, differing as to characteristics affecting their bonding ability. *See* Skeist Tr. 826-32." (Pet. Appx. A, p. 33a).

Based on all the foregoing evidence and specific findings, the Trial Court correctly concluded:

> "I thus conclude that, absent covering prior art, it was not obvious to the person of ordinary skill in the pertinent art to apply one of the Fisch lacquers to the foil of the Shanok process patent prior to introducing the foil into the extrusion apparatus" (Pet. Appx. A, p. 33a).

II

The second "question presented" also raises a routine patent question rightly decided by the courts below; there is no conflict with the *General Electric* decisions.

A. No general importance

Petitioner's second "Question Presented" raises essentially the same hindsight obviousness point as the first question. Petitioner argues that the invention was "obvious" under 35 U.S.C. 103* over three particular sheet lamination articles combined with the prior art Shanok patent (Petition, page 2).

At page 13, the petition complains that the District Court may have considered each of the three articles and the Shanok patent separately but never considered them combined:

> "The District Court apparently considered each of the heat-seal lamination prior art publications put in evidence by Dynex separately and never considered the *combined* teachings of the prior art Shanok '811 patent and the heat-seal lamination prior art." (original emphasis)

This matter of considering prior art in a patent case is well settled and requires no review by this Court. The controlling principles are clearly set out in *Graham* v. *John Deere Co.*, 383 U.S. 1 (1966) and were carefully followed by the Trial Court in the instant case. In *Graham*, page 17, this Court stated the requirements as follows:

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* 35 U.S.C. 103 appears at Pet. Appx. E, p. 58a.

> "Under §103, the scope and content of the prior art are to be determined, differences between the prior art and the claims at issue are to be ascertained; and the levels of ordinary skill in the pertinent art resolved. Against this background, the obviousness or non-obviousness of the subject matter is determined."

Here, as we show below, the District Court carefully followed *Graham*. Each of the three sheet lamination articles were considered alone and combined with Shanok. All were made the subject of fact findings by the Trial Court (Pet. Appx. 15a *et seq.*).

B. The courts below correctly decided the merit of the invention over the prior art.

The main prior art relied on by Dynex is the *Shanok Patent No. 2,774,881* (DX-Q; Pet. Appx. G, p. 67a). It is the same Shanok patent that was considered by the Patent Office Examiner and the Patent Office Board of Appeals before the patent in suit was granted (PX-3, App. E420). The Shanok patent deals with extruding unlacquered metal foil in thermoplastic. As the Trial Court found:

> "There is no suggestion of a wrinkling problem • • • nor the solution of such a problem." (Pet. Appx. A, p. 37a)

It is worth noting that the Shanok patent was invented by the Shanoks of Glass Laboratories, Anchor's major competitor. Glass owns the Shanok patent but has taken a license to practice the patent in suit (Pet. Appx. A, p. 33a).

The three prior art sheet lamination articles relied on by petitioner Dynex are even further removed. None of

them are as pertinent as the prior art considered by the Patent Office.

The *Modern Packaging* article (DX-Z; Pet. Appx. J, p. 95a) is concerned only with laminating sheets and wraps and doesn't even mention extrusion processes. The Trial Court found:

> "* * * the Modern Packaging article entitled 'Aluminum Foil' (DX-Z), deals with laminating sheets and wraps, and not with the extrusion process. The article refers to laminating plastic films with aluminum foil and the necessity of selecting the proper adhesives therefor." (Pet. Appx. A, p. 35a)

The *Alcoa* booklet (DX-X; Pet. Appx. H, p. 70a) teaches that, in the art of lamination, one brings together two or more sheet-like materials and passes them between a pair of rollers. Sometimes an adhesive is used and sometimes it is not (Pet. Appx. H, pp. 76a-77a).

So far as wrinkling is concerned, the booklet's teachings *cause* wrinkling. The Trial Court found (Pet. Appx. A, p. 35a):

> "The Alcoa article deals with laminating of sheets and wraps. My own analysis of this article leads me to credit and accept the testimony of plaintiff's expert (Bruins Tr. 432):
>
> > 'This article deals entirely with the subject of lamination and gives no advice on how to make an extruded product containing aluminum foil.'
>
> Moreover, as the same expert pointed out, wrinkling is mentioned in the Alcoa article in connection with hot melt adhesives. Thus, as is stated, if hot melt adhesives are applied to aluminum foil, the article teaches

that you will have wrinkling rather than avoiding it, causing said expert to state (Bruins Tr. 431):

> 'If the hot melt adhesive were applied to the aluminum it would cause it to be expanded, due to the higher temperature, and if you now combined it with a cold sheet in laminating, you would get wrinkling.' "

The last of the three sheet lamination articles cited in the petition is *"Coating and Coating Methods for Aluminum"* (DX-BV; Pet. Appx. I, p. 92a). There are references to extrusion in this article (pp. 93a, 94a) but it occurs *before* contact with any foil. The lamination is done as usual between a pair of pressure rolls. It is not the process of the Fisch patent in suit where metal foil and hot melted thermoplastic are extruded in unison through a die giving shape and contour to the product.

As to this article, the Trial Court found:

> "The next of the defendant's prior art references is the 'Paper, Film & Foil Converter' article (DX-BV). This article is concerned with methods of application and coating techniques to aluminum foil. In the extrusion process described in this article, a sheet of polyethylene is first extruded and the extruded sheet is *then* brought into contact with the foil, *but the foil does not pass through the extruder at all* (Bruins Tr. 435-436). There is no mention of a wrinkling problem, much less the answer to the problem. Defendant also relies on this prior art for its disclosure of adhesives to be used with aluminum foil. Again, however, it is for this purpose not as pertinent as that before the Patent Office. As for the extrusion process discussed, this item of prior art is less pertinent than Shanok." (Pet. Appx. A, p. 36a).

The Trial Court found that the pertinent art to which the invention pertained under 35 U.S.C. 103 was the art of extrusion and not lamination:

> "The art, I find, which is pertinent is the art of extruding a thermoplastic material about a metal foil. I do not accept the proposition urged by the defendant, that the level of ordinary skill is that of the experts called in this trial, Dr. Bruins and Dr. Skeist. From the proofs offered, I find that one of ordinary skill in the pertinent art would not have talents, as the experts did, in chemistry, or have knowledge of the many techniques applicable to the manufacturing of plastics, such as lamination." (Pet. Appx. A, p. 39a).

The Trial Court nevertheless considered all the Dynex lamination articles together with the extrusion art and found that the Fisch invention was non-obvious and patentable:

> "Moreover, even if his knowledge [one of ordinary skill] extended beyon[d] the narrow confines of the extrusion art, I find he still would not have seen or heard any teaching or suggestion as to the solution of the wrinkling problem.
>
> Accordingly taking the defendant's starting point on obviousness, the Shanok and Chadbourne patents, and *adding to them* the accretions of knowledge provided by defendant's prior art adhesive theory, I find that the person of ordinary skill in the art would not have recognized that the problem of wrinkling, and distortion by bending stresses, could be cured by application to the foil of one of the lacquers included in the claims in suit." (Pet. Appx. A, pp. 39a-40a).

The Trial Court also found that there was substantial evidence confirming the merit of the Fisch invention and

showing that it was a valuable contribution to the arts. These findings included recognition of the invention by important companies who took licenses, such as General Motors, and by sophisticated workers in the art who took a license, such as the Shanoks of the Shanok patent. The Court also found that the invention went into widespread use and was highly successful and that even Dynex paid tribute to the invention by infringing the patent (Pet. Appx. A, pp. 33a and 40a).

C. No conflict with the *General Electric* cases

Petitioner Dynex's assertion of conflict between the decision below and this Court's decision in *General Electric Co.* v. *Jewel Incandescent Lamp Co.*, 326 U.S. 242 (1945) and the Court of Appeals' decision in *Preuss* v. *General Electric Co., Inc.*, 392 F.2d 29 (C.A. 2, 1968), *cert. denied* 393 U.S. 834 (1968), is misplaced. In both of those cases there were clear teachings or suggestions of the inventions in the pertinent prior art.

In *Jewel Incandescent Lamp Co.* the patent related to an electric lamp bulb having its interior surface frosted by etching. The prior art showed how to frost the inside surface as well as how to produce the claimed surface of rounded rather than sharp angular crevices or pits. The District Court found the invention to be obvious.

Similarly, in *Preuss* v. *General Electric Co., Inc., supra,* the patent related to a method of FM stereo radio transmitting and receiving. The Court of Appeals made the factual inquiries required by *Graham* v. *John Deere Co., supra,* and found that the invention of the patent was obvious.

In the instant case, the Trial Court made the factual inquiries of *Graham* v. *John Deere Co., supra,* and found that the invention of the patent in suit was not obvious. The Court of Appeals affirmed. There is no conflict.

III

The third question presented (Pet. pp. 2-3) and the second reason presented for granting the writ (Pet. pp. 14-19) do not raise matters of general importance; the courts below correctly decided that the invention was not anticipated by the Nadeau patent.

In essence, the petition argues that the invention of claims 1, 2 and 3 of the Fisch patent in suit is anticipated by the prior art Nadeau patent and that the courts below erred by reading distinguishing words into the claims to save them from invalidity for lack of novelty under 35 U.S.C. 102.

The legal principles controlling the question have long since been settled and the matter simply turns on the facts. The petition does not fairly state the facts.

Actually, in the courts below, no words were read into the patent claims in suit to distinguish them from the prior art Nadeau reference. The courts below gave ordinary meaning to the words already in the patent claims in light of the invention described in the specifications.

Each of the three claims in suit expressly call for:

> "extruding a transparent thermoplastic material about the lacquer coated foil while feeding the foil in

> unison with the thermoplastic material * * *" (Pet. p. 6, fn. 3)

A "thermoplastic", by definition, is a material that can be repeatedly softened by heat and hardened by cooling (App. 233a).

As can be seen, claims 1, 2 and 3 state that a "thermoplastic" material is extruded "in unison" with the lacquer coated metal foil. Moreover, the thermoplastic material is said to be extruded "about" the lacquer coated foil. The metal foil goes *through* the die opening along with the hot melted thermoplastic material. To go *through* the die, the thermoplastic material must be hot and melted (App. 237a-240a). Thus, as the expert witness explained, the claim means "that the lacquer-coated foil and the molten thermoplastic are simultaneously fed into the die" (App. 243a).

The process of the Nadeau patent (Pet. Appx. L, p. 121a) is entirely different. It is directed to the preparation of an aluminum printing plate!

The Nadeau patent is concerned not with hot molten extrusion but with cool extrusion of a coating onto the aluminum plate (App. 356a-357a, 407a, 408a). The aluminum does not go through an extruder die head (App. 407a). The Trial Court found:

> "Nadeau says little of extrusion. In Column 10 of the patent, Nadeau refers to various techniques that can be employed at room temperature for applying the coatings to his aluminum plate, and, in addition to room temperature spraying and dipping, Nadeau men-

tions extrusion. The testimony persuades me that the extrusion was vastly different from that of the Fisch patent. Thus, I accept the testimony of plaintiff's expert, Professor Bruins, that the Nadeau patent was concerned with solvent extrusion at room temperature to lay down a coating; that Nadeau means 'not molten extrusion, but merely toothpaste, room temperature extrusion'; and that the aluminum foil in the process of the Nadeau patent does not go through the die head of the extruder." (Pet. Appx. A, p. 13a-14a).

IV

The fourth question presented (Pet. p. 3) and the third reason asserted for granting the writ (Pet. pp. 20-22) do not fairly arise from the record.

The petition's last point is directed to the notion that the patent claims in suit are invalid because they cover an inoperative combination. According to page 21 of the petition, there was uncontested testimony below showing that use in the patented process of cellulose acetate as the transparent thermoplastic and polyvinyl acetate-polyvinyl chloride as the lacquer on aluminum foil did not work.

The petition asserts that the Courts below saved the patent claims in suit from invalidity by limiting the claims to exclude such inoperative combination.

Such contention is incorrect.

The only testimony about the alleged inoperative combination was the testimony of the petitioner's witness Skeist. This testimony was based on a single *ex parte*

experiment conducted on the very eve of trial and was hotly contested by cross-examination (App. 691a-710a).

The Trial Court listened to Skeist's testimony, observed his demeanor, and then rejected Skeist's testimony in this very area (Pet. Appx. A, p. 42a):

> "I reject Dr. Skeist's testimony and the conclusion he drew from his *ex parte* experiments. Starting with an evident bias * * *, he proceeded on a less than scientific basis using only three experiments and the aforementioned three plastics, [i.e., only one experiment with cellulose acetate] took only 20-30 minutes and obviously made no earnest effort to succeed."

The Trial Court went on at Pet. Appx. A, p. 43a to specifically accept the testimony of Dr. Bruins, respondent's expert, "that the patent sufficiently details the process in suit and does not place an unreasonable burden of experimentation on anyone who wishes to practice the invention."

In rejecting Skeist's credibility, the Trial Court acted well within the scope of its authority:

> "In any event, the trial Judge refused to credit Mr. Levins testimony on which this claim is largely based; and this, of course, was an issue which was peculiarly for his judgment."—*H.M.L. Corp.* v. *General Foods Corp.*, 365 F.2d 77, 82 (3d Cir. 1966).

There is substantial evidence supporting the Trial Court's finding. Skeist conceded that contrary to what a person skilled in the art would do, he did not try to make the process of the invention work. Instead he admitted that he was trying his best to make his experiment fail (App. 703a). For example, Skeist made no attempt to vary

the physical conditions of the experiment to see whether he could succeed (App. 691a-692a, 694a, 708a).

Indeed, Skeist did not even try the transparent cellulose acetate thermoplastic with the lacquer the patent said could be used therewith. The Fisch patent at column 3, lines 27-28 and 33-37 teaches the use of cellulose acetate thermoplastic with cellulose nitrate lacquer. Yet Skeist declined to try that combination because, he said, he was interested in failing rather than succeeding (App. 701a-703a).

Moreover, even if Skeist's "test" were to be credited, the patent would not be invalidated.

The patent and the claims do not teach or claim use of each of the four Fisch lacquers with *all* thermoplastics. Instead, the claim is concerned with use of "*a*" transparent thermoplastic and leaves it to a person skilled in the art to pick one that he prefers.

Dynex successfully uses its infringing combination of vinyl chloride-vinyl acetate type lacquer called VMCH in combination with cellulose acetate butyrate. The latter is a well-known transparent thermoplastic sold in commerce in large quantities (App. 434a).

This Court has held that the patent need only serve to "guide those skilled in the art to its successful application." *Minerals Separation* v. *Hyde*, 242 U.S. 261, 271 (1916).

The patent here teaches that cellulose acetate can be used with cellulose nitrate. Respondent itself commercially

used cellulose acetate successfully in practicing the invention (App. 477a-478a), and both respondent and petitioner have used vinyl chloride-vinyl acetate lacquers in their commercial operations. Skeist admitted that there were many combinations of thermoplastic and foil that *would* work with at least one of the lacquers taught by the patent (App. 710a).

Consequently, the courts below correctly rejected petitioner's contention that either cellulose acetate or vinyl chloride-vinyl acetate lacquers are inoperative in the process of the invention.

Conclusion

For the foregoing reasons the petition for a writ of certiorari should be denied.

Respectfully submitted,

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May 22, 1974